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QUARTERLY

OF THE

National Fire Protection Association

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87 MILK STREET, BOSTON, MASS.

EDITED BY THE SECRETARY

National Fire Protection Association.

87 Milk Street, Boston, Mass.

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For Bravery.

The Quarterly

Vol. 7 October, 1913 No. 2

Hazards to Life. The second safety congress of the National Council for Industrial Safety, held in New York in September, registered certain progress in organized effort to cope with this great and difficult subject. The chairman of our new committee on Safety to Life, Mr. H. W. Forster, was unable to be present at this Congress, but the Association was represented by Chairman F. J. T. Stewart of the Executive Committee, who attended several of the sessions and who spoke at the meeting on the subject of Organization, assuring the Congress that the N. F. P. A. means to do its full share in this work so far as it relates to fire hazards. Mr. Chas. E. Meek, of our Executive Committee, presided at the afternoon session on which the subject of fire prevention was discussed. Two of our members were speakers at this session, Colonel Lewis T. Bryant of New Jersey, and Mr. H. F. J. Porter of New York. Both of these talks were illustrated by lantern slides.

In connection with this subject it is interesting to note that the Industrial Board of the New York State Department of Labor has been able to extend the jurisdiction of the existing labor law for buildings five stories or higher to cover four-story buildings. On and after October 1st New York factory buildings less than five stories high, and regularly occupied by twenty-five persons or more above the ground floor, must have their interior staircases serving as exits and the landings and passageways connected therewith encased on all sides in fire-resisting material. All interior openings must have self-closing doors similarly encased. It is very interesting to note that improved automatic sprinklers may, however, be provided in such buildings in lieu of the staircase protection unless more than eighty persons are employed above the ground floor. This recognition of the automatic sprinkler as a life saver is very gratifying to those whose experience indicates the supreme value of such

protection in all ordinary factories. This action of the Industrial Boar. of New York was precipitated by the Binghamton disaster, which was made the occasion for a special report by our committee on Safety to Life—the only report, so far as we are advised, that emphasized the value of automatic sprinkler protection.

It is very well to legislate on the subject of hazards to life, and the action of the Industrial Board of New York in extending the scope of the present law as indicated is admirable; but it is obvious that eternal vigilance in the enforcement of these laws is imperative and that alert public opinion must assist in the enforcement. The recent trial in the New York Court of Special Sessions of Max Blanck, one of the proprietors of the Triangle Waist Company, for locking the doors of his factory was an unhappy revelation to those from whose memory the horrors of the Triangle Waist Company holocaust of March, 1911, is not yet effaced. At the same time Blanck was arrested for locking his doors on the ninth floor. Albert Levy on the sixth floor was also arrested for locking his iron doors, while his father, Jonas Levy, and others in this loft were arrested for smoking in violation of the fire regulations. In the same building Henry Wallach, on the seventh floor, was arrested for having the doors to the fire escape locked. These revelations in the light of the Asch Building disaster are almost incredible, and the release of these men with light fines indicates the laggardness of the administration of justice in co-operating in the work of public safety. Max Blanck was fined $20, the minimum fine, by Chief Justice Russell, who stated that in view of the fact that the defendant had expressed a disposition to abide by the law in the future he would be lenient!

* * * * *

Official Responsibility. The recent wholesale cremation of convicts in an antiquated "cage" near Jackson, Miss., in which thirty-five Negro prisoners were burned to death, is a severe reflection upon that state, fully warranting all the criticism the disaster brought forth. While the flames ate away the only stairway leading to the second floor the prisoners tore vainly at the bars that covered the jail windows. Their screams brought prison attaches, but the flames drove back members of the rescue party. The convicts worked in the cotton fields of the state farm, and were housed in the "cage" at night. The wooden cage in which the convicts were confined was built ten years ago from old lumber taken from the penitentiary building in Jackson when that structure was destroyed to make room for the new state house. It was a two-story building, with only one means of entrance, and a narrow stairway leading from the first floor to the second. Hay, corn and molasses were stored on the first floor. Except on one of the state farms, all of the cages in which prisoners are confined are of similar construction and without any fire-fighting facilities.

The day following this disaster a serious fire occurred in the state penitentiary at Ossining, N. Y., in which fortunately no lives were lost.

It is probably too much at present to expect the ordinary public official to meet his responsibilities respecting fire protection while ninety per cent of the people cannot yet be induced to protect their own homes against fire. What can the poor convict expect of our humanity while the factory workers and even the school children are not properly cared for? So unusual is it for anyone in authority to take energetic action on fire hazards in public buildings that the recent closing of a portion of the Poughkeepsie High School by Mayor Frank because it was unsafe is a proceeding almost unprecedented.

It is gratifying to see this action commended by the press of New York. One of the metropolitan dailies, complimenting Mayor Frank, produced an editorial of dignity and high value:—

> It was what he probably prevented that should be his satisfaction.
>
> He may picture, in imagination, a night of terror, with glint of lanterns and toiling rescuers pulling out of ruins bodies of boys and girls, the city frantic in its grief. This mayor may rationally say to himself, "I prevented all that. It never occurred. I stood in the way of such human misery."
>
> The prevented disaster is greatly to the credit of the man who prevents it. It may be this moment impending in a factory, and some one man is certain that it impends. It may be the secret defect in some machinery, and only one man is sure of that defect. It may be on a railroad.
>
> To know the possibility is one of the most solemn calls that ever reaches a human ear. Do you know of such a danger? Are you thoroughly convinced of it? And are you the man in charge who could speak the word? How dare you keep silent?
>
> This is the proper use of the frightful narratives with which past calamities have tortured the public ear. Let one man who knows just imagine it in his place. Let him gaze long and hard on the picture of disaster. Then let him prevent it before he sleeps that night.
>
> It sounds queer, but is true, that some of the best deeds ever done in this world have been preventing dreadful deeds from ever being done. Of course the public does not measure the praise due that way. The praise is the approving voice in a man's own secret heart. There is no higher praise than that.

There is wide opportunity throughout the United States and Canada for men to win this sort of praise, and it is possible that as the public conscience is awakened other mayors may exhibit the courage shown by Mayor Frank.

* * * * *

Fire Drill Failures. The failure of the fire drill in the Binghamton fire has considerably disturbed those conscientious factory managers who have been operating such a drill for a considerable time, and new features or expedients are being advocated to quicken the interest of the employees.

One of these is the introduction of smoke. A smudge is made in the basement when the drill is rung in to make the performance realistic. This is certainly a dramatic adjunct, but unless the employees are notified in advance that smoke is to be used there is possibility of a panic which may cost life. If on the other hand they are notified of the innovation

the drill will be anticipated and the danger discounted. *Fire and Water Engineering* in a recent editorial on the exit drill says:—

> No one will deny that it has been the means of saving many lives, as instances can be mentioned where schools have been emptied of several hundred children when fire had been discovered in its incipient stage. But as a permanent means of emptying a large building of its human inhabitants with sufficient expeditiousness to prevent fatality, can the fire drill at all times be depended on? Many contingencies are to be taken into account in answering the question. In the first place, there is not a group of women employed in any factory where fire drills have been the custom that would not have done exactly what the girls in the Binghamton factory did—that is, many would have refused to move under the impression that it was only a drill, and not an actual fire. The frequency of these drills naturally becomes tiresome, and in most cases, if the operatives respond at all, it is a perfunctory action. This fact is recognized wherever fire drills are in vogue, but the fact is made public only when it is exposed by a real tragedy, as a result of the indifference born of over practice. As a preventive of panic and an indispensable aid to prompt and complete success the fire drill may be considered correct in theory. That it failed in practice at Binghamton was no fault of the drill system. To use a sporting expression, it was the result of "overtraining," thus prohibiting the very thing it was intended to accomplish. If the correct answer is not in abolishing the fire drill, it is in making it more serious by not overdoing it.

The best solution of the problem where division fire walls (insuring easy exit at each floor level) are not provided, is the installation of the automatic sprinkler. Where this life and property protector is present the factory owner need not disturb himself over lagging exit drills. If his sprinkler system is in operating condition his employees will have plenty of time to get out—unless the protecting equipment is wrecked by an explosion before it has a chance to operate. The fire records of the N. F. P. A. make this conclusion almost indisputable.

* * * * *

Water Waste. The dry summer and the enforced husbanding of water supplies by many municipalities has again served to emphasize the fact that water waste is a good running mate for the fire waste as a tax upon the people. Here too the careless, wasteful and profligate place undue burdens upon thrift and wisdom.

We have all heard the argument against the system of water meterage—that under such a system people will use insufficient water for cleanliness, thus impairing the general health of the city. It is well known, however, that where meters have been introduced there has been no such result, but on the other hand an immense gain has been registered in the saving of useless water waste and consequently in the revenue of the people. The engineering departments of all cities are pretty clear on this matter, but the political influence is always against restrictions.

A resident of the borough of Brooklyn wrote to the late Mayor Gaynor complaining of the conduct of the water commissioner in examining the plumbing in his house and requiring him to have a leaking faucet repaired—both of which actions he seemed to look upon as an intolerable invasion of private rights which should call for the immediate

dismissal of the official in question. Mayor Gaynor returned a reply which decidedly vindicated the city's water department. He showed that the waste of water through leaky and defective pipes and fixtures, because of the carelessness or niggardliness of householders, has been scandalous and little short of criminal at times, in view of the scarcity of water and the deprivation which many people had to endure—like wantonly wasting bread in time of threatening famine. The mayor said that in six months by the system of inspection which his correspondent complained of there was effected a daily saving of nineteen million gallons in Brooklyn, and more than sixty million gallons in Manhattan. "This reform," said the *New York Tribune*, "practically adds these large quantities to the available water supply of the city for the convenience, comfort and health of the people without lessening by a single drop the amount actually used by anybody. Reckoned at the meter rates, the saving to the city in value of water amounts to millions of dollars."

* * * * *

Clogged Standpipes. The recent discovery of clogged standpipes in the Whitehall Building in New York City, during an attempt at a high pressure test, suggests that this condition may obtain in the standpipe systems of many buildings in the cities throughout the country, some of which have stood for many years without test even of their hose connections. It is obvious that the standpipe is the one principal reliance of the skyscraper. No fire department can carry hose lines up more than four stories. There are many tall buildings of which the doors and trim are of wood and which are generously filled with wooden desks, if not more inflammable contents. A fire once started on floors above the reach of fire department hose lines would burn its way without molestation in many of the finest buildings in the country, should there be a failure of the standpipe at the critical time. Owners and engineers of buildings do not seem to realize the gravity of this situation and the need of frequent inspections, if not actual tests, of standpipes and connections. Chief John Kenlon declares that careless and lazy workmen in completing a building frequently throw bricks, dirt and cement into standpipes to save the trouble of carrying this refuse down stairs. A careful building owner will demand a test before accepting a standpipe equipment, but there are undoubtedly many such equipments throughout the country which have never been tested. There is a question of course as to the wisdom of frequent wetting of unlined linen hose, but this hose has been found by inspectors, more than once, badly eaten close to the connections by acid used in polishing the brass work. It might very well be considered a legitimate part of modern fire department inspection service to test out periodically all equipments of this character.

The Skyscraper. Those who attended the International Fire Appliance Exposition held last year in St. Petersburg, Russia, were surprised to find that no space was filled by American manufacturers of fire extinguishing apparatus. While there was practically none of these, means of fire prevention were very well represented. Investigation developed the fact that Russia has practically no use for much of the fire-fighting machinery in vogue in this country. It is reported that St. Petersburg does not employ motor fire apparatus or water towers of any considerable height. This is due to the fact that the legal height of buildings in St. Petersburg is seventy-seven feet. The houses are usually built in the form of a hollow square, making the interiors easily accessible, and the walls are thick and built of brick, mortar and concrete. All stairways are made of stone and cement. It is obvious that any serious fire in St. Petersburg is thus very rare, fire fighting being much less important than fire prevention. In contrast to this Russian city, with its tallest buildings less than one hundred feet, is our city of New York.

A list of the tall buildings on Manhattan Island has been prepared by our member Superintendent R. P. Miller of the Bureau of Buildings of the borough of Manhattan, and an inspection of the figures which follow is likely to prove interesting to many readers:—

Stories.	Buildings.	Stories.	Buildings.
10	179	23	3
11	181	24	4
12	191	26	4
13	389	27	2
14	44	31	1
15	27	32	1
16	28	33	3
17	31	38	1
18	13	41	1
19	13	45	1
20	12	55	1
21	15		
22	11	Total,	1,156

Basements also are included in the list where the floor of the first story is above grade and where there is an entrance into the basement from the street. Roof structures or penthouses when actually occupied for janitors' dwellings or some purpose other than for housing elevator machinery, stair exits, are considered as an additional story by the Building Department.

From this table it appears the average height of Manhattan skyscrapers (assuming anything ten stories or more in height to be a skyscraper) is thirteen stories.

Superintendent Miller estimates the total number of buildings in Manhattan at 120,000.

Other cities of the country, where not prohibited by law, are imitating New York in the matter of skyscrapers. Seattle has recently per-

mitted the erection of an absurdly tall building. When completed, with fire protection installed, the modern fireproof skyscraper gives a good account of itself when a fire occurs in it, providing the equipment is in operating condition. Oftentimes, however, fires occur high up in these buildings before the wooden framework is removed and while there is no equipment at hand for fire fighting. Three times in succession, within a few weeks last spring, the city of Detroit witnessed the spectacle of a fire in the top of a so-called fireproof skyscraper. The last of the three was in the nineteenth floor of the Ford Building. Before the firemen could get their line of hose up the fire escape the blaze had gained sufficient headway to cost the owner of the structure, Edward Ford of Toledo, $8,000 damage. The blaze started by spontaneous ignition of a heap of oily rags in the janitor's room at the top of the building. (Janitors in "fireproof" buildings are naturally careless.) Owing to the height, the water pressure was poor and the firemen made slow work of reducing the blaze.

It will be remembered that at one of our annual meetings in New York City our members had the privilege of witnessing this sort of a fire.

* * * * *

The Government Lends a Hand. The United States Government after many years of indifference to the fire hazard, not only of the country at large but that to which its own records were exposed, has recently made an appropriation for the installation of a modern system of auxiliary fire protection for three of the largest buildings occupied by the Department of the Interior in the city of Washington. A committee has been appointed to investigate the relative merits of systems adaptable to the buildings of the department and to prepare plans and specifications.

Another indication that a government fire prevention consciousness is developing comes from the chief of the fire department in Portland, Maine, who reports an inquiry from the government for information relative to the sizes of hose and the kind of couplings now in service in that city. It is the intention of the War Department to aid cities along the coast in fighting fires if, by chance, any of the vessels should be in port at the time of a conflagration. The information sought will be immediately sent to the Navy Yard at Portsmouth.

All of the big ships carry immense pumps and could throw large quantities of water. It is understood that similar requests have been made of the principal coast cities along the Atlantic.

* * * * *

N. F. P. A. Publications. The publications of the Association prepared and printed during the summer met with much favor at the hands of the membership. The Proceedings, comprising nearly 400 pages, makes an imposing volume, full of interesting discussions and much exceptionally valuable information.

In the Year-Book, now grown to a volume of 137 pages, a change was made in the listing of associate members outside of the United States. Our Canadian membership is shown by itself, making it easier for members in Canada to locate and get in touch with one another than when the Canadian names were scattered through the large volume of names in the United States. By this method of showing the membership in each country separately, it is easy to locate our foreign members and gain an immediate idea of the number of such in Great Britain, France, Germany and other countries which our members occasionally visit.

The Index to Publications, revised and re-issued under date of June, 1913, has given general satisfaction. The first section, in which the available publications are assembled, has proven an especial help to the new members of the Association. It is our thought to issue this section separately whenever the accumulation of valuable new publications shall warrant. Part 2, being a complete index to subjects covered in the printed records, is too arduous a task to permit of frequent revision.

* * * * *

Help Complete Some Files! The Patent Office Library of London, England, having become an associate member, is particularly desirous of establishing in London a complete set of National Fire Protection Association publications. A number of other important libraries are equally desirous of obtaining certain issues which are now out of print. A search by members who do not wish to bind or permanently preserve the Association's published Proceedings, QUARTERLY magazine, Special Hazard Bulletins, etc., would undoubtedly result in locating a number of copies of these desired issues. If such members will be good enough to refer to pages 65 and 66 of the Index, note such issues as are now out of print, and make a search of their files with the object of locating copies of the same, the Association's office will be very glad to pay express charges beside being very grateful to members willing to supply them.

Waste.

Berton Braley in *Farm and Fireside*.

Forest and field and orchard, mountains of coal and ore,
Mighty has been their bounty, limitless seemed their store;
So we have blithely squandered, so we have sacked and spoiled.
Boasting about our "progress," bragging of how we toiled,
Drunken with nature's bounty, we laid our plenteous gain
To the magic of Yankee hustle, to the vigor of Yankee brain,
And we looted the goodly forests and planted the wasteful crop,
And we hooted the careful prophet who said that the loot must stop!

Public Education.

The summer season and the consequent cessation of the calls for public speaking gives the office of the Association an opportunity to prepare and publish special bulletins of an educative character. The customary Independence Day Bulletin was issued in June and met with its usual popularity.

It is obvious, however, from the figures shown in this bulletin that the work of the Association on this special topic is pretty well accomplished, so thoroughly have the cities of the country awakened to the value of a rational Fourth of July celebration. It is doubtful if we shall need to issue further bulletins on this subject.

The popularity of Fire Prevention Day, especially in the progressive Middle and Western States, and the frequent calls upon the Association for counsel in the manner of its celebration suggested the preparation and issue of the Fire Prevention Day Program mailed to members early in September. The calls for this publication have been considerable from all parts of the United States and Canada and many appreciative communications have been received regarding its character and make-up.

The bulletin on the Hazards of the Shingle Roof, although just issued, already gives promise of a wide circulation and popularity. It will doubtless be extensively used in support of the movement for incombustible roofs, which is beginning to make headway throughout the country despite vigorous organized opposition on the part of special interests.

The bulletin on Dwelling-house Hazards, also just issued, will meet a need which has existed for a long time. In the many problems of large properties with which the Association has had to deal the hazards of the home have not received the attention which they clearly deserve. The importance of such a bulletin as this was called to our attention by member Charles H. Patton of Cleveland, who also rendered valuable service in the preparation of it. These four bulletins constitute an effective summer offering.

* * * * *

The most interesting contribution in the way of summer public speaking was made by our New York member Mr. Frank Lock, Manager of the Atlas Assurance Company, who appeared upon the program of

the annual convention of our active member the International Association of Fire Engineers, speaking on the subject of Over-Insurance and Its Relation to Incendiarism. There has been a vast deal of loose talk on this subject not substantiated by facts. The term incendiarism itself has scarcely been analyzed or understood. Mr. Lock's scholarly paper, of which our active member the National Board of Fire Underwriters generously supplied us with a sufficient number of copies for mailing to our members, shows clearly that the incendiary is a creature of various motives and that with the great majority of incendiary fires the question of insurance or over-insurance has nothing to do. We have long needed an authoritative word from a responsible underwriter on this subject, and Mr. Lock's address before the Fire Engineers admirably meets the situation. It will be printed in the Proceedings of the Convention, and there is no doubt that it will modify the utterances of many of the fire chiefs while in no way modifying their desire to stamp out all incendiary fires. It is perfectly well known to all students of the question that insurance companies cannot regulate incendiarism. It is a work for public authorities after considerable public education. Insurance companies have repeatedly failed in their efforts to convict an incendiary because of the perverse sympathy in America for the man who has a fire. When every fire is made the subject of an inquest and the man who has a fire comes to be considered a public enemy, juries will not then hesitate to convict the firebug and withhold from him his calculated gain. This point is very clearly made in Mr. Frank Lock's excellent address.

* * * * *

Our Chicago member Mr. Albert Blauvelt, one of the most interesting of the Association's speakers, delivered an address on Fire Waste Reduction at the annual convention of the American Meat Packers Association at the Hotel Sherman in Chicago in September. At this meeting Mr. Blauvelt outlined the interesting theory of which he has long been an advocate that a sharing in fire loss by the assured to the extent of from five to ten per cent of the loss on each fire (the insurance being drawn to provide no cover whatever for this first percentage of the sound values) would radically reduce the fire waste by making all insurers exceptionally careful in their housekeeping and attitude toward fire prevention. In addition to the discussion of this theory Mr. Blauvelt reviewed briefly the fire hazards of packing houses, touching upon the general subject of fire prevention. Among other things he said:—

> Referring to the practical details of fire prevention in packing plants, one of the first things noticeable is that a large packing establishment has so many processes and employs so many trades that there are comparatively few causes of fire that are not to be found in packing houses.
>
> There are, however, a few well worn rules which will always bear repetition. First, it is necessary to have a genuine fear of fire on the part of both master and man.
>
> Second, cleanliness where apparently unnecessary and where there is not the slightest visible indication that cleanliness would do any good is nevertheless a great preventive of fire.

One of the reasons for fewer fires per capita in Europe is the fact that all waste paper, broken wood and trash of every description has a value and is picked up constantly.

The same thing applies in a packing house to corners and cubby-holes throughout the plant or throughout the yard even although the trash may be scrap iron. There is a certain something which makes fires less frequent where everything is kept open, clean and clear.

Third, on direct heat hazards, gas jets, soldering operations, furnaces, electric lamp bulbs, cookers and all other uses of heat, an excellent rule is to remember that anything that is not comfortable to the hand will sooner or later set fire to wood.

Therefore the electric bulb too warm for the hand requires to go in a cage; the heat over a gas jet where too warm for the hand requires to be protected; the bottom of a cooker similarly requires an air space. The roof around a boiler stack requires to be cut away to a point where the hand is always comfortable, and so on for all uses of manufacturing heat.

* * * * *

Former President Wm. H. Merrill never fails to respond to the Association's requests for his services as a speaker. The new Railway Fire Protection Association which is being promoted by the leading members of our Committee on Railroad Properties held its first meeting at Chicago in the Hotel Sherman, October 7th and 8th. A speaker from the Association being desired for this meeting. Mr. Merrill consented to appear upon the program of the first day. His address was arranged as the last item on the afternoon program, the meeting being adjourned at the close of his address to pay a visit to the plant of the Underwriters' Laboratories to witness certain tests which Mr. Merrill had arranged for that day. The railroad fire protection engineers were exceedingly interested in the Laboratories, and the result of their visit will undoubtedly mean such co-operation from the railway representatives as will make for still further progress in uniformity and standardization of fire protection engineering practices.

* * * * *

The severe drouth of the summer, particularly in the Middle Western States, entailed serious problems of water supply and fire hazards in those states. Our member Mr. Chas. E. Eldridge of Topeka, Kan., issued special bulletins, "Impaired Fire Protection" and "Increased Fire Hazard from Drouth Conditions" to which the Kansas newspapers gave generous space. He also issued a special bulletin to the mayors and councils of all Kansas cities on the subject of deficient water supply and fire prevention. The publicity given these bulletins undoubtedly prevented many fires as the cautions appearing in them were printed on special posters by the officials of a number of cities and conspicuously posted. A long period of drouth is a nervous time for those towns and cities built largely of wood, as in many of them at such a time the water supply is barely sufficient for ordinary purposes and a serious fire might empty the reservoirs completely.

Mr. F. R. Morgaridge, Assistant State Fire Marshal of Illinois, has been issuing a most interesting and instructive series of bulletins this year containing suggestions and copies of paragraphs of the statutes relating to the handling of explosives, inflammable oils, etc., and making suggestions for protection against lightning which has been a devastating force in recent years in the Middle States. Bulletin No. 17 contains a reprint of the Fire Works Ordinance suggested by the National Fire Protection Association, all mayors and city councils in the state being requested to make the same or one similar in character a part of the laws of the state.

* * * * *

Our Los Angeles member, Captain Henry T. Hill of the Los Angeles Fire Department, delivered an address on fire prevention as a means of safeguarding the property of the city rather than the extinguishing of fires, at the opening of new fire department headquarters in the adjacent seaside resort, Venice, which was visited by such a disastrous fire last year. Among other things Captain Hill said:—

The fire chiefs of to-day (and in some of our Eastern cities the mayor and councilmen and even commissioners) have recognized the value of fire prevention as well as fire protection, and through experimentation have accomplished a good deal—or at least enough to cause them to establish a permanent bureau. I am sorry to have to admit that as a matter of comparison we of this famous and progressive state of California are somewhat delinquent in this respect, but sooner or later I hope we will get the germ, and then watch us grow! If I speak correctly you have in Venice a part paid and a part volunteer department. While the volunteer departments have long been the jest of our comic writers and the press, they are nevertheless ahead of the paid departments of a few years ago. But volunteer or paid departments, no matter how efficient and how up-to-date the equipment, are not all that is necessary for us to-day. We have got to take another step and branch out in advance of fire fighting and get at the cause and whenever and wherever we locate any unnecessary hazard see that it is not only removed at that time but that it does not occur again. Fire prevention is the latest asset to any modern up-to date department and is gradually growing to be the most important part of the department in time of peace.

* * * * *

Our friends the Credit Men are still in evidence as fire prevention experts. Mr. Herbert E. Choate of Atlanta, Ga., who was principally responsible for making effective Secretary Wentworth's visit to Atlanta on his tour with Mr. Meek, delivered an address on fire prevention at the convention of the Southern Merchants' Association at Atlanta in August. Among other things Mr. Choate said:—

I may sympathize with the man who is overtaken by disaster, even though he could have avoided it, but I own to a tremendous respect for the man who has the forethought and judgment to fortify himself against such a mishap.

Permit me to say frankly, as my opinion, that a business that cannot pay for fire protection has no proper license to exist; for fire protection is just as essentially a part of the cost of doing business as the freight, the taxes, or the rent you pay, and your profits should be figured accordingly.

And are you aware that the insurance rates for different classes are made in strict accordance with the risk that the companies carry? And since the exposure

of a stock of goods in a highly inflammable, balloon constructed, pitch pine building, without even the provision of emergency buckets filled with water, is the highest type of mercantile risk and yet the average country condition, "there's the reason" —the reason the country and small town rate seems prohibitive.

What are business men doing to overcome this largely preventable loss? Not a great deal, I am afraid, in proportion to the gravity of the problem, though I am glad to say that the largest organization of business men in the country, the National Association of Credit Men, is making a systematic and persistent effort to stimulate thought along that line.

The truth is that until recent years we have been supinely indifferent to the situation, fondly cherishing the delusion that the insurance companies pay the bills.

* * * * *

An interesting feature in connection with forest fire prevention is the fact that several of the railroads have sufficiently awakened to their responsibility to give space in their summer time tables to cautions respecting forest fires. The following paragraph is taken from the summer time table of the Rutland Railroad:—

Prevent Forest Fires.

DO YOU REALIZE that hundreds of human lives and millions of dollars worth of property are destroyed each year by forest fires?

DO YOU REALIZE that most of this loss may be avoided by the exercise of caution by all who go into the woods for business or pleasure?

DO YOU REALIZE that in New York State alone there are industries dependent upon wood manufacture products worth nearly $400,000,000 annually, and employing 200,000 people?

DO YOU REALIZE that the sum of $20 is spent, largely in wages, on every thousand board feet of timber which is taken from the forest, and that when that amount of timber is destroyed by fire, there is a loss to the community far in excess of $20?

DO YOU REALIZE that one forest fire may completely destroy the attractive features of your favorite mountain trail or camping ground?

DO YOU REALIZE that nature unassisted requires hundreds of years to re-establish a forest which has been destroyed by a bad forest fire?

YOU SHOULD REALIZE THESE FACTS, AND BE CAREFUL WITH FIRE WHEN IN OR NEAR THE FOREST.

DON'T drop lighted matches or throw them out of the car window where they may start forest fires.

DON'T leave burning cigars, cigarettes or pipe ashes where they may set fire to inflammable material.

DON'T leave your camp fire until you are sure it is out.

EXERCISE THE SAME CARE WITH FIRE IN THE FOREST THAT YOU WOULD TAKE WITHOUT QUESTION IN YOUR OWN HOME OR IN THE CITY. THE LAW REQUIRES IT.

PREVENTION OF FIRES MEANS A SAVING TO EVERY MEMBER OF THE COMMUNITY. WON'T YOU HELP?

* * * * *

Our active member, the Canadian Manufacturers Association, held its annual convention in September in Halifax, N. S. At the conclusion of the report of the Insurance Committee (which referred to the work of

the National Fire Protection Association, the visit of its secretary to Canada last year and the appointment of its new Committee on Public Information), the following resolution was unanimously adopted:—

The Association wishes to particularly commend the suggestion of the Insurance Committee that the incoming Committee should, during the year, give full prominence to an effort to awaken our members to the enormous and rapidly growing fire waste of the Dominion, and we believe it opportune to urge all manufacturers to enforce elemental precautions against the occurrence of fires which are so often due to a lack of care and cleanliness or from overcrowding.

We desire to reaffirm the resolution passed at the Ottawa meeting, urging upon the various Provincial Legislatures the adoption of adequate fire marshal laws and the necessary appropriations to make the same effective. We further suggest that our members bring the subject to the attention of their representatives in their respective local Houses of Parliament with a view to enlisting their active co-operation and support.

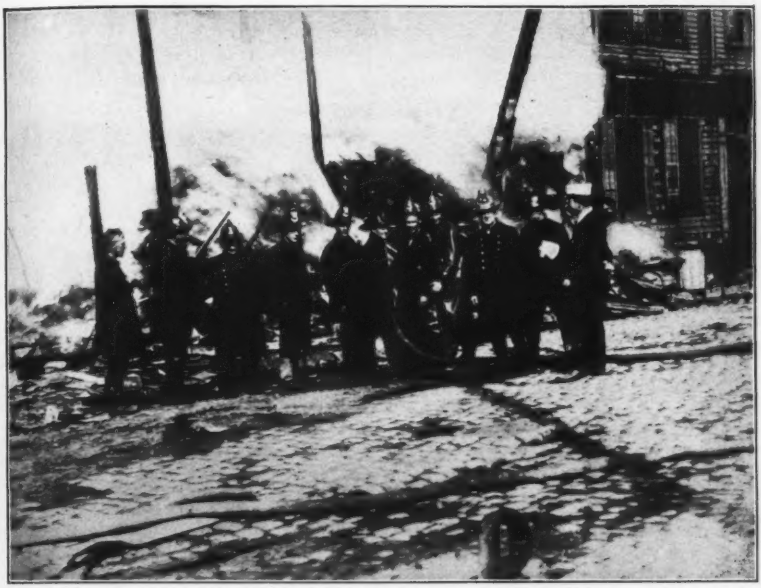
The Canadian Manufacturers Association is planning another speaking tour for Secretary Wentworth during the week of November 24th in the large cities of the Dominion.

* * * * *

There is in France a national fire prevention association entitled the Institut Francais de la Prevention du Feu. It was founded July 1, 1909, by Henri Favrel. The Institute has very graciously conferred honorary membership upon the President and Secretary of the N. F. P. A. An interesting monthly bulletin of small but well printed character is issued. Mr. Favrel is an associate member of the N. F. P. A.

* * * * *

Our New York member John Kenlon, Chief of the New York Fire Department, has written an imposing book, *Fires and Fire Fighters*, which is published by the Geo. H. Doran Company of New York at a price of $2.50 net. So many leaves out of the experience of such a long time fire fighter as Chief Kenlon are certain to contain much that will interest and instruct. This is true of Chief Kenlon's book. It is well illustrated and makes a considerable addition to the current studies of fire fighting.



This is not a company of Dutch comedians. It is the Jersey City fire department putting out the million dollar conflagration August, 1913. The shifting of the wind, blowing the flames due east where there was nothing to catch fire, and the strenuous efforts of certain manufacturers in the vicinity who headed parties of their employees to keep their buildings wet down, prevented a much greater conflagration.

The Jersey City Fire Department.

OPERATION: *Discipline.*—The fire department is badly demoralized and practically devoid of discipline, due to political influence exerted throughout the department.—*Hudson Inspection Bureau; Report on Jersey City, N. J., December, 1911.*

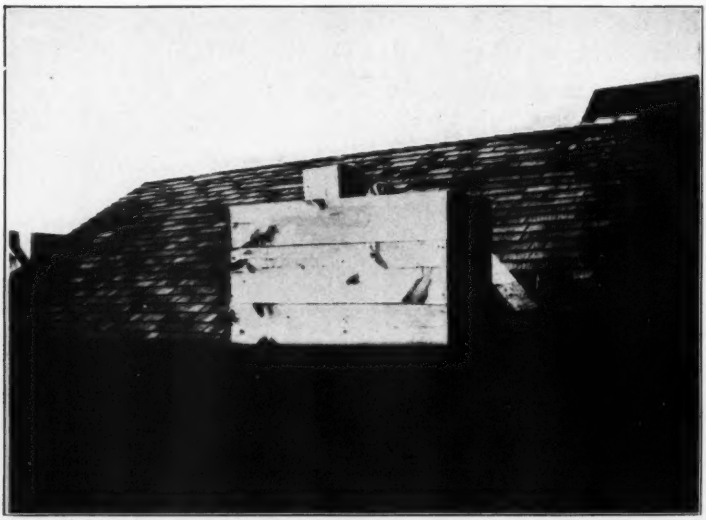
By a vote of 4 to 1, and against the protest of Mayor Fagan, the Board of City Commissioners of Jersey City, N. J., after a protracted discussion, refused permission for the proposed investigation of the city's fire fighting service by experts under the direction of the National Board of Fire Underwriters. The commissioners, in defending their action, made the remarkable allegation that at a previous investigation the experts injured the city's fire equipment during the tests. The request for permission had been endorsed by the Chamber of Commerce of Jersey City. Although the National Board will not get the chance to probe the Jersey City Fire Department, it is more than probable that as a result of the facts brought out at the meeting in the course of the peppery debate, some other kind of an investigation will be ordered. Commissioner Moore

favors an inquiry by some expert who is not allied with the Underwriters, against which most of the criticism seemed to be directed by the citizens who attended the meeting in the City Hall. Commissioner Hague, to whom this matter had been referred at a previous meeting of the board, reported against the proposition for a probe on the ground that such a probe might endanger the fire apparatus, some of the tests made by the Underwriters on former occasions having been far too severe for it. It was claimed that some of the engines were disabled after the experts of the Underwriters got through with them.

Commissioner Hague produced Fire Engineer Sonneborn, who has charge of the fire department repair shops. Sonneborn told about the last inspection made by the Fire Underwriters. "The Fire Underwriters put our engines to such a severe test," said Sonneborn, "that several of the engines had to be sent away for repairs, and the city was put to heavy expense and the fire department was temporarily crippled."

Sonneborn admitted that of the nineteen fire engines now owned by the city eight are in very good condition. The others are not what they should be. Mayor Fagan seized this statement as a corroboration of the claim that there is room for improvement in the fire department and that the city would be the gainer if all the facts could be brought out.

New York Journal of Commerce.



Photograph from Kansas City member.

Chimney construction in Missouri.

The contractor started up with a four-brick flue (four bricks around a 4 x 4 inch opening) and continued this construction until he got to the roof. He then placed over this flue a single length of 8 x 8 inch fire clay flue lining. In order to get the architectural effect of a larger chimney he then built a wooden box around the flue which was to be plastered with stucco.

Dust Explosions.

Engineering News.

Every engineering student and every engineer should have indelibly impressed upon his memory a clear understanding of the fact that any combustible material whatever, when in the form of fine dust, offers the possibility of a disastrous explosion. Every little while this possibility becomes a grim reality, as happened at Buffalo in June when a huge plant for drying and storing grain and manufacturing grain products was instantly wrecked with a loss of over thirty lives.

The Buffalo disaster in the Husted Mills is typical of such fatal calamities, and because of the large number of the victims and the wide publicity given to it, it ought to serve a useful purpose in impressing on the public as well as on engineers the inherent danger in all such combustible dust.

Notwithstanding the many dust explosions on record, one reading a report of the testimony recently taken at the coroner's inquest in Buffalo on the victims of the Husted elevator explosion might suppose that such explosions had been practically unknown hitherto. For example, one of the principal witnesses at the inquest was the general superintendent of the mill, who is a graduate in chemical engineering from Cornell University. He described the various precautions taken to guard against fire and explosion, such as the wire-guarded electric-light bulbs, the placing of wires in conduits, the rules against smoking, the requirements that switching locomotives should not run into the buildings, but not a word as to the cause which in his opinion had produced the explosion. The assistant superintendent could give no information as to any causes which might result in such an explosion as that of June 24th. The chemist at work in the plant's laboratory at the time of the explosion had no information concerning the dust in the mill and had not studied grain-dust explosions. A millwright employed in the plant testified that there was even less than the usual amount of dust on the floors, as the place had been given a thorough cleaning a few days earlier. Another millwright gave similar testimony. Numerous other witnesses were brought forward to testify that the mill and its equipment were in good condition and apparently safe. Having developed by this remarkable testimony that there was no assignable cause for the explosion, the inquest was adjourned for experts to be called by the state in the endeavor to learn why the explosion occurred.

One can readily understand that in a coroner's inquest, where it is attempted to fix criminal responsibility upon some person or persons for a disaster involving large loss of life, there is a very natural tendency to cover up the facts, scientific and otherwise, and shroud the whole affair with a cloak of mystery.

To any competent engineer or chemist, however, there is no mystery whatever in what occurred at Buffalo. It is merely the last of a long, long series of dust explosions which during the past half century have cost thousands upon thousands of lives and many millions of dollars of valuable property. It is well established that in most coal-mining explosions the destructive agent is not gas, but fine dust. Flour mills, grain elevators, candy factories, starch works and numerous other industries in which fine organic dust is distributed through the air have each contributed its quota of victims to teach the lesson as to the explosibility of fine inflammable dust.

Mention may be made also of the numerous disasters which have occurred in connection with the burning of powdered coal. Many in the cement industry will recall especially the disastrous explosion at the Edison cement works nearly a dozen years ago in which Professor Darling and a number of others lost their lives.

There is one point regarding dust explosions which deserves especial emphasis and which every engineer particularly ought to understand, and that is that only a very small quantity of dust is required to create a most violent explosion.

The proportions of dust to air for complete combustion may be set roughly as one pound of dust to from ten to twenty pounds of air. By volume the proportion would be one part of dust to several thousand parts of air. But these proportions are not necessary to cause disaster. If the particles of dust floating in the air are close enough together so that flame may be transmitted from one particle to the next, there may be a fatal accident even if no explosion occurs. A writer in the *Railway Age Gazette*, of July 18th, describes a fatal disaster in the powdered-coal plant of a cement mill as follows:—

> All these explosions are caused by impalpably fine dust floating in the air in suspension. This floats in layers or strata. At a recent explosion (?) in one of our biggest cement plants a foreman and some of his men were repairing and cleaning a coal-grinding mill. One of the men had rammed a piece of waste on the end of a stick into a part he was cleaning and somehow (no one knows) it caught fire as he pulled it out. Immediately there was a swift hissing sound like a pinwheel going off, or escaping steam, and in a flash this indescribable death traveled the length of the room, down a stairway and back several times in layers just like a train of powder, only there was no report, no explosion, just a hissing. The men came out—they were absolutely denuded, yet seemed to retain all their faculties. The foreman said: "I'm done for and am going to die." He still had enough life in him to tell what had happened before he became unconscious. They all died very shortly afterward.

With our present-day knowledge of the nature of combustion, there is no mystery whatever about what occurs in a dust explosion. Twenty-five

or thirty years ago a popular scientific lecturer in England demonstrated in a most convincing way the nature of combustion and explosion. He had a series of chambers filled with various combustibles of different fineness graded all the way from kindling wood down to fine shavings and then to fine dust. He thus demonstrated to the audience how the smaller the particles of the combustible, the more rapid is its combination with the oxygen of the air and the greater the resultant pressure. With fine shavings placed under a box, sufficient explosive pressure was produced as they were ignited to raise the box some distance; but whereas the shavings require several seconds to burn, fine particles of organic dust which can float in the air require only a very minute fraction of a second. When one clearly understands that even the explosion of such substances as gunpowder or dynamite is only an extremely rapid combustion, the mystery of the explosion of combustible dust floating in air ceases to be a mystery.

A dust explosion wrecked, and the fire which followed further damaged the plant of the Clover Leaf Milling Co., Buffalo, N. Y., September 13th. The disaster closely resembles the explosion at the Husted Mills in Buffalo, June 24, 1913, although the results were less serious. The plant parallels the tracks of the Pennsylvania Railroad and consists of a main brick building four stories in height, flanked on two sides with one-story brick storage sheds or warehouses. The office of the concern adjoins the northerly warehouse. At the time of the explosion the bins contained about eighty cars of grain. Three explosions occurred in rapid succession, and as the walls collapsed there was an outburst of flames which seemed to envelop the entire building.

According to the officers of the company and the mill foreman, bits of grit and other substances escaped the sifter or screen and dropped into the mill proper, where they were crushed between the rapidly turning wheels. Resulting sparks set fire to the fine particles floating throughout the mill room.

The mills had started work at 2.30 a. m. and had been running about fifteen minutes when the first explosion took place. There were about 30 men at work at the time, a few on the top floors, the rest on the ground floor; during normal operation the concern employs about 100 men. At the time of the arrival of the firemen the mill was in flames and so rapid was the spread of the fire that before the second and third companies of firemen could get their apparatus into action, the roof and top floors collapsed. The grain was ruined.

Six men were injured, one probably fatally; the other five recovered. The company had recently installed new ventilators and safety devices as a precaution against dust explosions.

The company estimates its loss at between $150,000 and $200,000.

Hobble Skirts Dangerous at Fires.

The accompanying illustration shows factory employees on a common outside iron fire escape and the difficulty that would be experienced in a rapid descent of it by women. Miss Sarah Christopher of New York is conducting a fire drill and indulging in a little plain talk :—

N. Y. Tribune.
Hobble Skirt a Menace to Life in Case of Fire.

"You cannot tell what terrible tragedy may be lurking behind these narrow skirts. You can't move freely in them. Even now, when you aren't frightened and are climbing more or less slowly, you feel yourself caught at every step. Some day when the smoke is pouring from the windows and the girls behind are pushing, you will catch your knee in that narrow skirt and down you will go. It won't be your own life only. It will mean the lives of all the girls behind you, who will fall over you, blocking the way. Stop and think when you are tempted to wear an extreme skirt what you would do if there came the call of 'Fire!' Of course this applies only to the extremely narrow skirt — the freak skirt. You will learn for yourselves just how wide a skirt you can wear, for we will have fire drills enough to test all your clothes. As a matter of fact, the narrow skirt is safer than the very wide one. The full, pleated skirt is really far more dangerous, because it catches on knobs and nails, and people behind you step on it, or you have to use both hands to hold it up, and you haven't anything to hang onto the fire escape with. The narrow skirt you can at least pull up around your knees and get it out of the way. No, forget all that false modesty. People aren't interested in your legs when your lives are in danger. Better a leg on the fire escape than a corpse in the morgue."

Inspection of Buildings and Contents by Uniformed Members of Fire Departments.

By H. C. Bunker (Chief of Fire Department, Cincinnati, Ohio.)*

Inspection of buildings and contents for fire hazards by uniformed members of the fire department is no longer an experiment in Cincinnati. This work, introduced by the authorities last year, is now a permanent feature of the department and its success fully justifies the time and effort devoted to it. Not only has it had a beneficial effect in reducing fire waste, but it has proved of exceptional educational value. It has been prosecuted without additional expense to the department by the assignment of active firemen to this work, and the detailing for this purpose of men from the companies has not had any appreciable effect upon the fire-fighting efficiency of the companies. When the idea of detailing active firemen to this work of inspection was first proposed it aroused considerable discussion, and many looked askance at the plan. It was something new, this proposition of sending firemen into buildings to look them over to see if conditions favorable to the outbreak and spread of fires existed. It was finding a new occupation for firemen, something different from their ordinary duties of working at fires, attending their daily house duties and biding their time in the engine houses waiting for the joker to drop. The inspections, such as were proposed, had probably never before been attempted on so ambitious a scale. The innovation was watched with much interest as the system was gradually introduced and perfected. Both the public and the firemen were open-minded in the matter, and little opposition was encountered when the inspections were put in force. The introduction of the system, however, was not made without meeting several obstacles. Chief among these was the assignment of men to the work without handicapping the companies. The districting of the city, the system of checking up inspections and the follow-up system of reinspection all were modified and adjusted from time to time, until now the system is on a very simple and practicable basis. The system now in vogue is briefly this:

System of Inspection.

The entire city is divided into districts, each company being assigned a district for inspection. This inspection is taken up block by block, each block being completed before another is entered. The buildings found in good condition are not reinspected, except upon complaint, until their respective blocks are again reached in regular rotation. Those found in bad condition are followed up until the conditions are rectified. The

* Read at the 1913 convention of the International Association of Fire Engineers.

records of each inspection of each block are kept together and are not filed permanently until all the buildings in the particular block are reported O. K. When a company finishes the inspection of its district it starts over the same ground again. The inspections are made during such hours as the other duties of the men will permit. Each company has a minimum strength prescribed by the chief, which force it must always have on hand ready to respond to an alarm of fire. This requires the inspections to be made between meal times, and allows about five hours a day for this work. All members of the company are supposed to take their turn in making inspections so that the extra duty does not fall on one or two men in the company, but all get their share of it. It is true that this has its disadvantages, as some men are more capable than others, but this is set off by the educational value of the work. As each member is accountable for the inspections made by him, and in case of fire on the premises his inspection is checked up, the average member is careful and particular and the average result secured has been good. Its educational value lies in the knowledge gained of the construction and arrangement of buildings in general, a quickening of the powers of observation and acquaintance with particular buildings in the company's district. The various members show more or less interest in and aptitude for the work, and some have developed a keen interest and particular aptitude. The inspection of a building is checked up by the fireman as it is made, on a form provided by the department. This is in duplicate in a loose-leaf booklet. It acts as a guide for the inspector. The items comprise the location of the building, its construction, its height, occupants of each floor, contents of inflammables, conditions of ingresses and egresses, especially with reference to stairways and fire escapes, the arrangement of contents preventing reasonable egress, the dangerous condition of chimneys and roofs, the condition of heating and lighting systems, facts pertaining to elevators and switchboards, fire-extinguishment appliances on hand, location and character of entrances to the building. The inspector reports what conditions in his judgment are unsafe, and sets a certain time in which in his judgment repairs should be completed and conditions remedied. The inspector not only is required to carefully look after rubbish, combustibles and other dangerous materials, but to note obvious defects in the construction of the buildings, particularly with reference to flues, gas connections and electric wiring. The men carry copies of the building code, with whose general provisions they are expected to familiarize themselves.

These reports are examined by the officer in charge of the company and by the district marshal (or battalion chief). They are filed by the company officer according to blocks in a large envelope bearing a sketch of the bounds of the block, and are held by him until a block is cleared up, when they are forwarded to headquarters and permanently filed, duplicate copies being kept at the company's station for future reference. When a condition needing attention is reported, notice is served on the owner or occupant, and a certain time is set in which to remedy the condition. At the expiration of this period a reinspection is made, and if the order has not been

complied with the case is referred to headquarters. Dangerous and unusual conditions are immediately reported to headquarters and given prompt attention. The original reports sent to headquarters are carefully examined before filing. Any report found incomplete, vague or unsatisfactory is returned to the company with instructions to make a reinspection and report more explicitly. A report is not filed until it is entirely satisfactory to headquarters.

When an owner or occupant (whoever in the opinion of the inspector or district marshal is most responsible for the care of the premises) refuses or neglects to comply with an order of the inspecting officer after a reasonable time has expired, a written notice is sent him from the chief's office, requiring him to comply with the original order within a limited number of days. This notice contains a copy of the ordinance prescribing the authority of the chief in the matter. A copy of this notice is sent to the company reporting the conditions, which returns an attached stub when the conditions have been completely remedied. The following is a copy of the ordinance under which the chief acts:

Ordinance No. 2565.

Empowering and authorizing the Chief of the Fire Department of the City of Cincinnati to inspect buildings and other structures; to order the correction of the conditions therein which he may find to tend toward endangering property and life by fire; to appoint Deputy Inspectors to make such inspection and punishing disobedience of such orders.

Be it ordained by the Council of the City of Cincinnati, County of Hamilton, and State of Ohio:

SECTION 1. The Chief of the Fire Department is hereby empowered and authorized to at any and all reasonable times enter upon and into any premises, building or structure within the corporate limits of the City of Cincinnati for the purpose of examining and inspecting the same to ascertain the condition thereof with regard to the presence, arrangement of deposit of any articles, materials, substances, goods, wares or merchandise which may have a tendency to create danger of or from fire in said premises, building or structure, or to create danger in case of fire on or in the same, or personal injury to or loss of life of the occupants of or persons on or in said premises, building or structure; also with regard to the condition, size, arrangement and efficiency of any and all appliances for protection against fire on or in such premises, building or structure.

SECTION 2. If he shall find upon such inspection of such premises, building or structure any rubbish, debris, waste or inflammable or combustible materials, and that the same is not so arranged or disposed as to afford reasonable safeguard against the dangers of fire, or if he shall find that the articles, materials, goods, wares and merchandise, on or in said premises, building or structure are so arranged and disposed that the occupants thereof or persons rightfully on or in the same would not, because of such arrangement and disposition, be afforded reasonable access to the exits of said premises, building or structure in case of fire, or if he shall find that by reason of such arrangement or disposition the members of the Fire Department would unnecessarily and unreasonably be interfered with in the exercise of their duties in and about such premises, building or structure in case of fire in the same, he may order in writing the removal of such rubbish, debris, waste or inflammable or combustible materials from said premises, building or structure, or the disposing and arranging of the same on or in said premises, building or structure in such manner as will remove such danger from fire. He may also order in writing that such articles, materials, goods, wares or merchandise be

so arranged and disposed on or in said premises, building or structure that the occupants thereof, or the persons rightfully on or in the same, will be afforded all reasonable access to the exits from the same in case of fire, and the members of the Fire Department will be afforded all reasonable facilities for the discharge of their duties in and about said premises, building or structure in case of fire.

SECTION 3. If he shall find that the appliances on or in such premises, building or structure for protection against fire are not in proper condition, or of insufficient size or number, or are otherwise insufficient for the purpose for which the same are designed and intended, or if he shall find that such appliances are reasonably necessary for the protection of such premises, building or structure and are wholly wanting, he shall order, in the case of such improper condition or insufficiency, that the same be placed in proper condition and rendered reasonably sufficient to afford reasonable protection against fire, and in the case of absence of such appliances where he may find that they are reasonably necessary for protection against fire, he shall order the installation of appliances sufficient to afford such reasonable protection in case of fire to said premises, building or structure and to the occupants thereof or persons rightfully on or in the same.

SECTION 4. The Chief of the Fire Department hereby is empowered and authorized to appoint such and as many deputies to make the inspections hereinbefore provided for, who shall report in writing the results of their inspections to the Chief of the Fire Department and who are hereby empowered and authorized to make such orders in respect to the conditions found by them on inspection as are hereby authorized to be made by the Chief of the Fire Department. Should any owner, lessee or occupant of any premises, building or structure or the owner or person in control of any materials, goods, wares or merchandise consider themselves aggrieved by such order of such deputy, he may, within twenty-four hours after the said order has been served on him, appeal to the Chief of the Fire Department, who shall thereupon make such order in the premises as in his discretion he may deem right and reasonable, and said order shall be final.

SECTION 5. Such order or orders hereinbefore mentioned shall be directed to the owner, lessee or occupant of such premises, building or structure, or to the person in control of the articles, materials, goods, wares or merchandise herein referred to, or to the owner thereof, as the circumstances may require, and it is hereby made the duty of such owner, lessee, or occupant of such premises, building or structure, and of such person in control of such articles, materials, goods, wares and merchandise, or the owner thereof, to comply with such order or orders with all reasonable dispatch and diligence.

SECTION 6. Any owner, lessee or occupant of such building, premises or structure, or in any person in control of such articles, materials, goods, wares, and merchandise as hereinabove referred to, or the owner thereof, who shall fail or neglect to discharge the duties imposed by this ordinance and the orders of the Chief of the Fire Department, or the deputies appointed by him under this ordinance, on conviction thereof, shall be fined not less than Ten Dollars or not more than One Hundred Dollars for each day of failure or neglect.

SECTION 7. The terms "owner," "lessee," "occupant," "person in control of" as used in the foregoing, shall be construed to include the plural, as well as the singular, and artificial persons as well as real.

Punishment for Violation.

Failure to comply with the written order of the chief is sufficient grounds for a police court warrant. This warrant is sworn to by the district marshal after a personal inspection of the premises when the chief's order is not complied with, and the owner is prosecuted in police court. Since July 10, 1912, when the first report was received under the present system, some 52,000 buildings (of about 80,000 located in the city) have been

thoroughly inspected and reports made and acted upon. Of these, several hundred were referred to the building commissioner for attention because of the extensive repairs required or where an inspection by this department's trained inspectors was necessary to determine what corrections are necessary. Quite a number of dilapidated buildings have been condemned and ordered destroyed by the building commissioner in cases brought to his attention by the firemen. In many cases it was necessary to send a written order from the chief before the owner would act. This notice, however, usually produced the desired action, and it has been necessary only in twelve cases so far to have recourse to police court prosecution. However, in most cases ready compliance with the orders of the firemen was made. The majority gave an attentive ear to the suggestions and advice of the firemen and remedied the conditions immediately. The general public as a rule complied readily and cheerfully. It has been found that the average owner or occupant will heed what a uniformed fireman tells him personally, where he will ignore, neglect or forget a notice or letter to the same purpose. In several cases the notice from the fire department was the first information that owners had of the conditions existing, as they visit their properties rarely or not at all. In these cases the responsibility for the neglected conditions was generally found to rest with the real estate agents. The inspections have been the means of unearthing many dangerous conditions, of securing the removal of tons upon tons of rubbish, refuse, dust-covered and in many instances oil-soaked; of clearing passageways and hallways, windows and doorways of barricades made by the careless arrangement of stocks, fixtures and furniture. Many unsafe, dilapidated and hazardous conditions have been rectified that otherwise would probably never have been discovered.

The removal of this rubbish and the rectifying of bad conditions eliminated many sources of fires and diminished the rapid spread of the flames in case of fire, thus giving the department a chance to get the fire before it got away. An appreciable reduction in fire waste can be attributed to it. Incidentally, the department's "working time" was reduced 1,800 hours within one year. It resulted in the cleaning up of many buildings that had never experienced the sensation before. It resulted in the employment of many carpenters, tinners, gas fitters and others, for the property owners were forced to make repairs that otherwise would not have been made.

In the department itself the system has been of exceptional educational value to the members, has given them employment during many hours that otherwise would have been spent in idleness at the firehouses, has acquainted the members with the construction, arrangement and conditions in buildings in their company's district. This knowledge, such as the location of stairways, shafts, elevators, skylights, the general plan of the building, the entrances, etc., has proved of much worth, especially at night fires, and permitted faster and more accurate work. Not only the member making the inspection, but the other members, gain this knowledge through conversation about the engine house.

The department also makes weekly inspections of all theatres in the

city. Because of the exceptional nature of this work, it has been assigned to a detail of two fire captains, who are thoroughly reliable and especially trained in the work. The detail examines every piece of scenery or stage trimming used in the theatres, and all this stuff is subjected to the "blow-torch" test and must withstand this test or it cannot be used at a performance. This fireproofing is not only required of all scenery, drops, etc., but of all decorations used at shows and exhibitions such as auto shows, machinery exhibits, pageants, etc.

This detail also inspects the moving-picture theatres of the city, paying particular attention to the fireproofing about the stage and of the scenery and drapery. In conclusion, I can only repeat what I said in the beginning, and that is that the inspection by the firemen of Cincinnati has proved a decided success from every standpoint.

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"YE'RE TOO LATE, CHIEF. ME AN' 'LIGE PUT IT OUT."
"WELL, YE HADN'T NO RIGHT TO. YE KNOWED VERY WELL WE WAS COMIN'."

Monitor Nozzle Protection for Pulp Wood Piles.

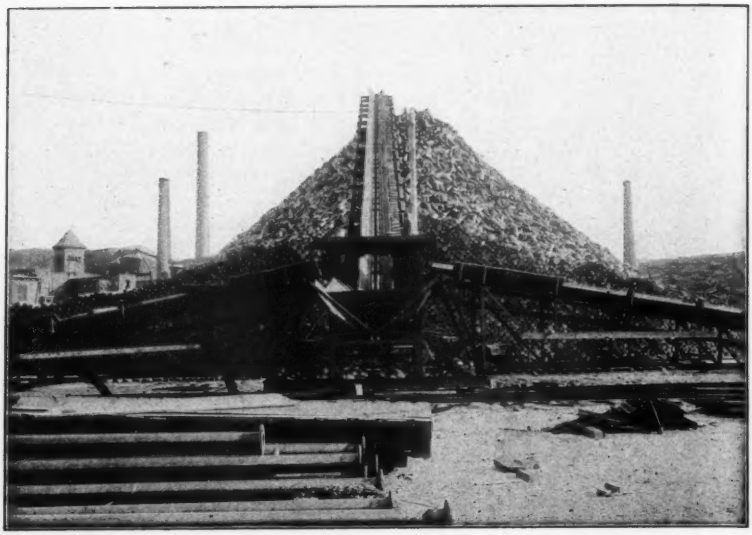
By "C. F. U. A.," Montreal (Member N. F. P. A.)

The pulp wood at some of the pulp and paper mills covers a large ground area, and is ordinarily piled to a height of fifty to sixty feet, and in extreme cases considerably more. Various methods have been adopted for piling, viz., chain or other conveyors on permanent wood or iron trestles, sluice ways or gravity slides from cutting mills at higher elevations to the wood piles lower down, or traveling cranes known to the trade as pulp wood stackers, pilers or loaders. It is the last type this article has reference to.

Some of these cranes are over one hundred feet long, and are built either in a rigid position or to operate in a vertical plane. The base is supported on tracks similar to those of a railway, to permit of the crane being moved around the area on which the piling is to be done. The power is usually electric, and a traveling belt on the crane conveys the pulp wood to any desired height within the limit of the apparatus.

A mill owner about to erect a new plant has suggested that better protection against fire than is now afforded by hose streams from the ground level could be secured for these large pulp wood piles if a four-inch pipe were permanently attached to a crane, with a proper discharge outlet at its upper end, and arrangement made to attach the lower end by means of a siamese hose connection to the nearest hydrant. Manufacturers of cranes and of monitor nozzles have been communicated with by the Canadian Fire Underwriters' Association, the intention being to use for the discharge a monitor nozzle operated from the ground level, for while the cranes generally contain a walkway, it would be dangerous for any one to attempt to operate a nozzle from the top of crane under conditions likely to prevail during a fire.

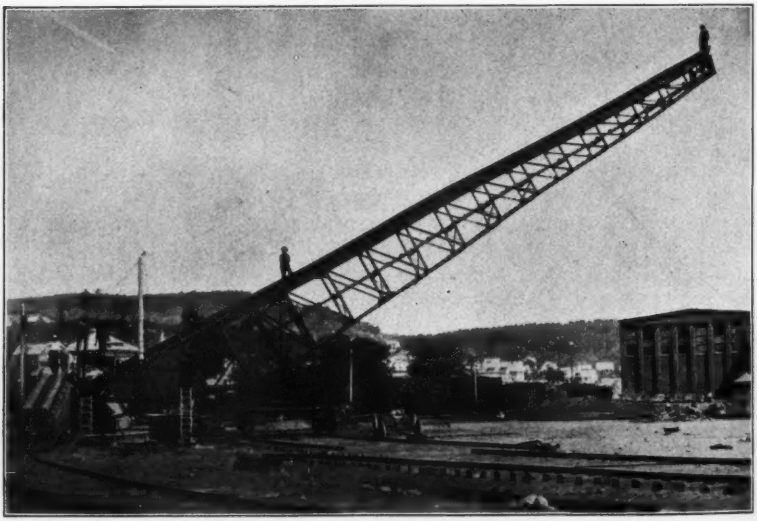
The arrangement is pronounced practicable by the manufacturers, and the estimated cost moderate. While all of the details have not yet been worked out, it appears that by means of a wire cable on brass pulleys the nozzle can be properly controlled from the ground level. The size of the orifice of the nozzle will depend upon the water supply, with one and one eighth inch as a minimum. The pipe should be of galvanized iron well fastened to the crane and properly painted with at least two coats. The hose connections could be located on the outside of the operating house



Courtesy of the M. Garland Co.

Traveling Pulp Log Unloader at work.

on the crane, and a supply of hose carried here if desired. The hydrants that would be used to connect with this pipe should be placed closer



Courtesy of the M. Garland Co.

Traveling Pulp Log Unloader, side elevation.

together than would otherwise be called for; or made at least three-way, with outside independent hose gates in any case, so that ordinary hose streams would be available until the monitor nozzle could be brought into action. The water supply should be capable of furnishing an abundance of water at a good pressure, and the power to operate the crane should be available at all times. It is not considered necessary by the manufacturers to cover the nozzle as a protection against the weather; but it is desirable to keep the nozzle normally turned down, especially in winter, so that snow and ice would not clog it. While that is the season of the year it would be the hardest to operate, it is also the one in which it is the least likely to be called upon in the northern climes, as the pulp wood becomes so frozen it is blasted apart by dynamite at some mills.

A moniter nozzle arranged as above would serve somewhat as a water tower, and should be more effective than hose streams from the ground for a fire in a high pile, especially near the top, and the added protection would seem to warrant the small extra cost.

NOTE.—Since the article was written, the mill owner referred to has advised he will install such a monitor nozzle. It may, therefore, be possible in some later issue of the QUARTERLY to describe an actual test. The crane that will be erected will permit an extreme height of piling of 125 feet.

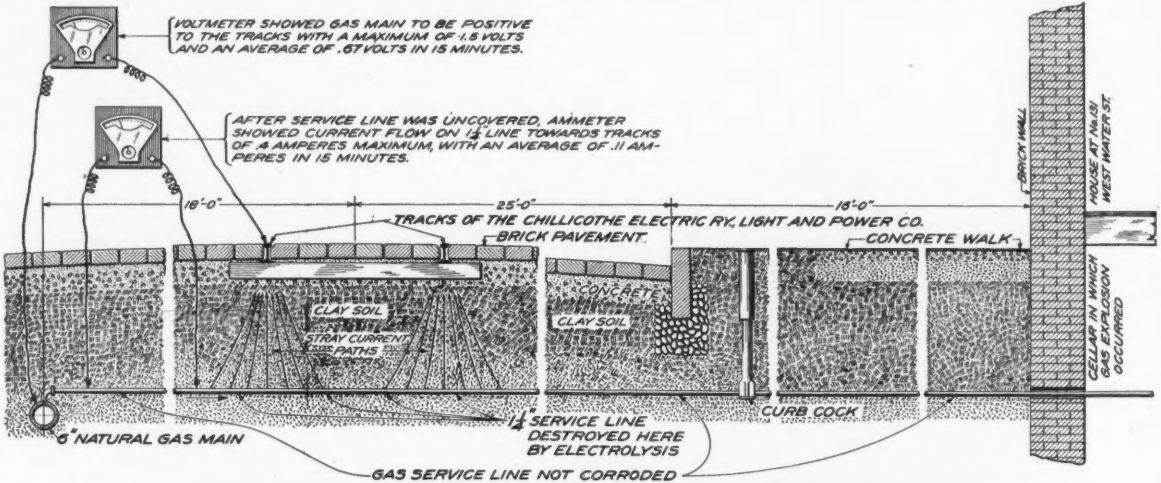
Fire Hazards Due to Stray Electric Currents from Single Trolley Street Railway Return Circuits.

By Samuel S. Wyer (Consulting Engineer, Columbus, Ohio).

Member: American Society Mechanical Engineers.
American Institute of Mining Engineers.
American Association for the Advancement of Science.

In every electric street railway it is necessary to have a closed circuit in order to permit the current to return to its source at the power station after having performed the useful work of propelling the cars. Except in Washington, D. C., and Cincinnati, Ohio, where the double trolley system is used,—that is, where one trolley is positive and the other negative,—this return circuit is made by means of the rails which are in contact with the street soil. The current, after having passed through the motor, goes out through the car axle and wheel to the rail and is then *supposed* to return to the power plant by traveling along the rails. However, in many cases the current leaves the rails and gets on to underground gas pipes, water pipes and lead sheathes of underground cables, and uses these paths as short cuts to the power station.

Wherever the return current leaves such underground metallic structures to go into the soil it produces a chemical action or corrosion—known as electrolysis—at the point where it leaves the metallic object. This cor-


VOLTMETER SHOWED GAS MAIN TO BE POSITIVE TO THE TRACKS WITH A MAXIMUM OF 1.5 VOLTS AND AN AVERAGE OF .67 VOLTS IN 15 MINUTES.
AFTER SERVICE LINE WAS UNCOVERED, AMMETER SHOWED CURRENT FLOW ON 1/4" LINE TOWARDS TRACKS OF .4 AMPERES MAXIMUM, WITH AN AVERAGE OF .11 AMPERES IN 15 MINUTES.
18'-0"
25'-0"
18'-0"
TRACKS OF THE CHILLICOTHE ELECTRIC RY, LIGHT AND POWER CO.
BRICK PAVEMENT
CONCRETE WALK
BRICK WALL
HOUSE AT No.49 WEST WATER ST.
CELLAR IN WHICH GAS EXPLOSION OCCURRED
CLAY SOIL
STRAY CURRENT PATHS
CONCRETE
CLAY SOIL
CURB COCK
6" NATURAL GAS MAIN
1/4" SERVICE LINE DESTROYED HERE BY ELECTROLYSIS
GAS SERVICE LINE NOT CORRODED

HOW STRAY CURRENTS FROM THE CHILLICOTHE ELECTRIC STREET RY. CAUSED A GAS EXPLOSION

rosion never occurs where the current goes *on* to the underground metallic structures, but only and *always* where the current leaves such underground metallic structures to go into the soil. It is especially dangerous to have

Figure 2. Natural Gas Pipe in original position.

these stray currents wandering around on underground water and gas lines, because the currents will eventually leave the pipes and then:

1. Produce favorable conditions for the failure of water lines at a critical time in case of fire. This is especially dangerous where direct pressure waterworks systems are used, and where the pressure is increased for fire fighting purposes. In such a case the corroded water main might carry the ordinary domestic pressure, and yet fail completely when the increased fire pressure is applied, thus leaving not only the burning risk, but adjacent risks without fire protection.
2. Produce favorable conditions for the leaking of gas, thus increasing the danger of gas explosions.
3. Where the stray currents come into a building on water or gas service lines, favorable conditions are produced for sparking or arcing on the plumbing fixtures in the building, thereby greatly increasing the fire hazard in the building.

The accompanying drawing shows the relation of a natural gas service line to a street railway track at Chillicothe, Ohio, where the stray currents carried by the gas trunk lines went over on to the gas service line at 131 W. Water St. and then jumped back to the rails of the electric railway, thereby corroding the service line and allowing the gas to work into the basement of the house which the service line supplied. An explosive mixture of gas and air was formed in the basement, and this coming into contact with an open flame, resulted in a disastrous gas explosion on June 6, 1913. Figure 2 shows the corroded condition of this service line immediately under the rail-

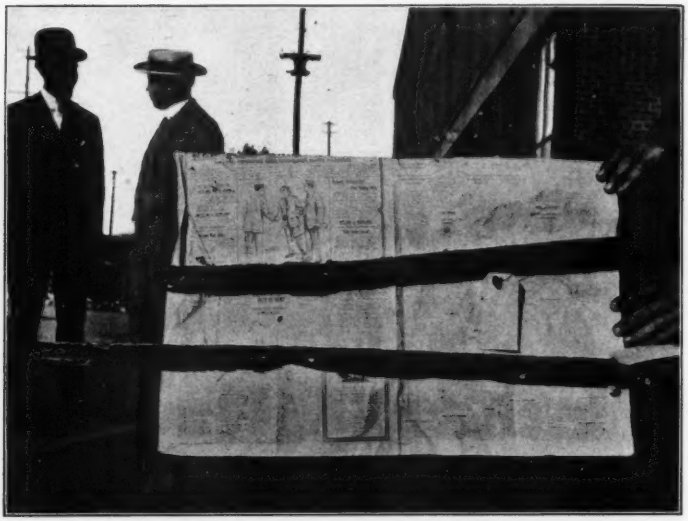


Figure 3. Natural Gas Pipe after removal.

way tracks with the soil removed, but with the line still in its normal position. Figure 3 shows the condition of this line after it was removed. Figure 4 shows a secret bond between the rail and the gas line, which was installed to use the gas line as a part of the railway company's return circuit.

Figure 5 shows the remains of the Western rooming house, corner of Sixth and Walnut Streets, Mansfield, Ohio, where a disastrous gas explosion occurred on January 8, 1912, which was due to the corrosion of the natural gas service line by stray currents, which corrosion permitted the gas to escape into the basement and thereby form an explosive mixture which resulted in the explosion.

Figure 6 shows two illustrations of the "pitting effect" of stray electric currents when arcing or jumping from one pipe to another in a building. This particular exhibit is a 1-inch gas service line taken from the cellar at No. 256 North Main Street, Mansfield, Ohio. The stray currents from the uninsulated return circuit of the local electric street railway entered the building on this gas service pipe, which was nine volts positive to an adjacent water service line. People walking on the floor above caused the pipes to vibrate and the stray currents to arc, producing the pit as shown. Prior to the removal, during a period of forty-one consecutive minutes, the current flow varied from 20 to 260 amperes, with an average of 108 amperes.

This abnormal condition produced a double fire hazard:

1. The danger of setting fire to adjacent inflammable material from the flame produced by the arcing current.
2. The inevitable gas explosion which will follow the making of a hole in a gas service pipe by an electric arc.

Figure 4. Secret bond to gas pipe.

The fire hazard from these stray currents is a serious menace to the life and property of a town, and the return circuit condition of a local street railway ought to be well considered and understood.

The elimination of this fire hazard will require one of two things:

1. The use of the double trolley system, as operated in Washington, D. C., and in Cincinnati, Ohio; or
2. Providing first-class track conditions and adequate bonding at the rail joints, with enough negative copper to take the current off the rails at intervals so as to keep the voltage drop down to such a point that the return currents will have little tendency to shunt off on to underground metallic structures.

In plan 2 it is important to bear in mind that all metallic conductors forming parts of the return electric circuit must be insulated from the ground wherever it is practicable so to insulate them; or if in case of any particular metallic conductor such insulation shall be impracticable, then in such case the said particular metallic conductor which cannot be insulated

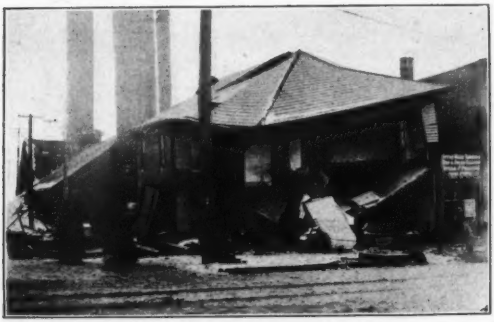
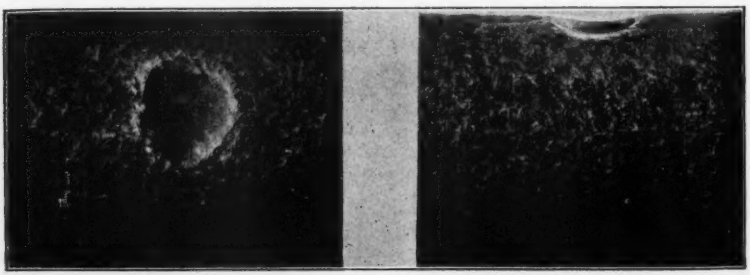


Figure 5. Rooming-house wrecked by gas explosion due to electrolysis.

must be so constructed and maintained as to afford as high resistance to ground as practicable.

In the present state of the art, as determined by extended studies and practical experience in this country and abroad, it is entirely feasible to keep the voltage drop down to a point so that the average potential difference, during any ten consecutive minutes, between any two points on the rails 1,000 feet apart, will not exceed one volt; and so that the average potential difference during any ten consecutive minutes between any two points on the rails more than 1,000 feet apart, within the limits of the ordinary city, will not exceed seven volts.

Several ordinances containing these voltage limits have already been enacted, and these regulations are in line with the electrolysis regulations of the British Board of Trade and the German regulations compiled by the joint electrolysis committee representing the German Society of Gas and Water Engineers, as printed in the *Electrotechnische Zeitschrift* of May 25, 1911.

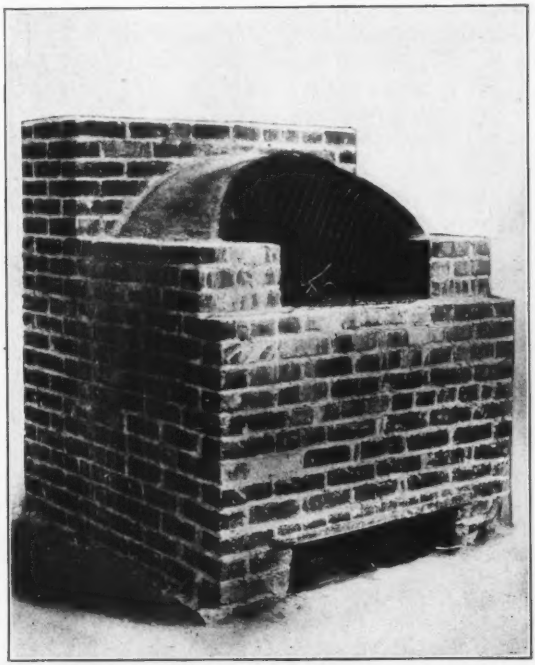


(*a*) Front view. (*b*) Side view.

Figure 6. Pipe pitted by electrolysis.

Municipal Waste Incinerator.

Finding that it was cheaper to reduce waste paper and other light, bulky and inflammable refuse to ashes, before taking it to the public dump, the city officials of Glendale, Cal., have decided upon the incinerator plan, and have adopted the type shown in the accompanying illustration. This incinerator is four feet square and the chimney portion



Courtesy of *Brick and Clay Record.*

is five feet in height. The interior dimensions are three feet by three feet, while the height of the enclosure is about four feet. At the upper front side is an opening through which the material to be burned is thrown, and over which a wire screen, with a two-inch mesh, is replaced, after the refuse is inserted. The flue is six inches by twenty-seven inches and is covered at the top by a screen, to prevent any large pieces of the burning material escaping.

There is a large draft hole at the lower portion of the front side, this being eight inches by twenty-seven inches, the brickwork above the opening being supported by a strip of one-inch angle iron. A fire grate of

one-inch angle iron is built on the inside of the incinerator, just above the draft opening.

These incinerators cost about $17 each, erected in place, and are installed at convenient points in the city, particularly at the rear of large business houses, the disposal of the paper and other light waste from these establishments having formerly been one of the economic problems of the thriving California municipality.

Arrangements are being made to have the refuse that is swept or carried out of the various establishments brought to the nearest incinerator immediately after the close of the business day, and the burning is done during the early night hours. The ashes are sufficiently cooled by morning to be gathered up by the public carts, and the bulk being infinitesimal, as compared to the bulk of the waste previous to burning, a great economy is effected. Plans are on foot to make some use of the ashes, it being claimed in some quarters that they will constitute, in themselves, a valuable by-product of this public-ownership plan.

Watchmen and Signaling Systems.

Their Money-Worth in Connection with Losses Under Automatic Sprinklers.

By Albert Blauvelt (Member N. F. P. A.).

This discussion is general (as shown by footnotes) and includes night watchmen, patrol men and the various types of signals and alarms. Arguing from fire records and an extended observation in the field, this paper undertakes to show the reasonableness of the following propositions:—

A. The main need for a watchman or a signal in connection with sprinkler fires is to save (or call help to save) water damage by shutting off water judiciously.

B. The unavoidable water damage for safe fire control by sprinklers (as an average) is the greater part of all water damage possible.

C. The value of a night watchman in strict relation to sprinkler fires is not his value proper, which latter is not covered by this paper. His value proper [1] is as a thief guard, a boiler tender, a night reporter, a yard hydrant man against exposures, etc.

D. The money value of a water-flow local signal, a central station water-flow signal, a watchman, or a thermostat, either singly or in any combination, does not exceed $30 per $100,000 at risk per year for mercantile or warehouse occupancies and, similarly, $20 for manufacturing occupancies.

E. The difference of value between a local water-flow alarm, a central station water-flow alarm, a thermostat system, or a night watchman as related to sprinkler losses, does not exceed five dollars yearly per $100,000 at risk for all occupancies.

[1] This view is emphasized in a letter from Member E. V. French.

F. The losses of record or losses averted of record do not show any quotable value for tank and gate signals when considered apart from water-flow signals.

G. Fire department aid by use of water as compared to needless damage by fire department hose streams [2] are subjects so much disputed that no money record can be adduced for or against watchmen or signals on the one point of calling for water via a fire department.

The writer is aware that the money-worth of night men and signal systems as credited herein is far below that credited by many inspectors, particularly by those who do not reckon what the cost, up-keep, wages or rental charges may be, as against any fire cost saved.

The favorite arguments of the men who over-estimate the value of watchmen and signals are based on supposititious cases: "if" a fire were to occur the results would "then" be "so and so," etc. This is like the argument that pins save the lives of many people who do not swallow them. It would seem better to abide by our actual sprinklered fire results.

A sprinkler equipment if it will operate at all does so unaided by man or signal, and while this paper holds that it is better to have a man or signal than to pay no attention to a sprinkler fire, it is fair to note that watchmen, and whoever else may work at a sprinkler fire, *do not shut off water judiciously*, the N. F. P. A. records showing twenty-seven sprinkler failures [3] due to water shut off too soon. Water flowing too long after a sprinkler fire is not mentioned at all as a cause of "unsatisfactory sprinkler fires" in N. F. P. A. records, which would seem an indication that "excess water damage" amounts to less than generally supposed.

The writer believes that the N. F. P. A. records are correctly made up and that the cost of shutting off water too soon is the fault of day help as well as night help and therefore not chargeable against watchmen or signals, but should be charged to general loss account.

The Watchman.

Let us consider the value of night watchmen (unaided by an alarm) in relation to the sprinkler fires in mercantile and pure storage occupancies, omitting manufacturing occupancies, and take up in detail: (*a*) the water damage necessarily due to a sprinkler fire; (*b*) the field experience as to how much more damage usually occurs if water is not shut off in season; (*c*) deduct fires during work hours and in non-water-damage locations; (*d*) deduct watchman failures and (*e*) note watchman's final likelihood of being of service.

A review of the fire records will show that the number of sprinklers which operate and the area thereby first flooded contributes more directly to water damage than any other fact. A sprinkler system must ordinarily be expected to operate for say twenty minutes; particularly at night. (Not but that some fires are discovered, controlled and the flow of water stopped promptly; but few of us would complain of an average of twenty

[2] Mentioned in N. F. P. A. Proceedings by the late Member W. S. Stratton as "Fire Department Exposure."

[3] See April, 1913, Quarterly, Page 498.

minutes[4] for night fires, bearing in mind that some fires are naturally persistent because inside of stock piles, under benches, shelving, tables, etc.)

The quantity of water needed for extinguishment ordinarily does the greater part of all the water damage possible. This inundation of a foot (or say six inches) of water soaks everything under the sprinklers and also most of the goods to which the water can soak through floors, etc., after which time the water usually locates a runway and the loss thereafter usually increases slowly. There are a few cases to the contrary, but any one who will scan the loss records and take note of the small losses (despite delay of shut-off) which do not attract attention, and set these against the few large and advertised losses, will find that it is a fair statement to say that neglect to shut off sprinklers after a fire rarely causes a large excess percentage of loss.

The most costly sprinkler loss plus excess water damage loss the writer has been able to locate was the Hayden fire at Omaha in 1906.[5] When, as in this case, thirteen sprinklers open, it means that the fire is inside or under stock piles; otherwise it would be extinguished by the first few heads. This in turn means that the Hayden fire could not have been quickly controlled nor the water be quickly shut off with safety; which in turn made unavoidable an inundation over a large area on the fifth floor of a leaky-floored building filled with mercantile stock. The loss on this fire adjusted out at thirty-four per cent, of which not half (or say not over fifteen per cent) of the sound value can be fairly charged to excess water damage due to a known long delay in shutting off.

The N. F. P. A. records present more than a thousand fires in mercantile and storage occupancies,[6] also a long list of watchmen failures, and alarm failures, cases of failures to find valves, etc. (detail records in Western Factory Insurance Association office also agree), thus indicating (as against the Hayden case and a few others) over a hundred cases of upper-floor fires with long-continued flow of water. The "excess water damage" cannot have been very important or it would long ago have taken a classification as a cause of "unsatisfactory fires," as earlier intimated.

It seems well supported by N. F. P. A. and Western fire records that for damageable locations in mercantile risks the expectation of loss due to neglect to shut off water after a fire is extinguished (good and bad luck cases combined) need not be over three per cent of the values, or,

[4]This view is concurred in by Members E. V. French, W. A. Stoney, F. A. Rye, E. T. Cairns and others.

[5]This loss occurred in a mercantile property having no watchman and no water-flow signal.

[6]Out of table No. 9, Page 503–505, April, 1913, Quarterly, viz.:

Cold Storage	4
Cotton Warehouses	146
Department Stores	240
Drug Houses	99
Mercantile	426
Warehouses	92
Wool Storage	23
	1030

reckoning $300,000 as an average contents value for sprinklered mercantile and storage risks, an average expectation not exceeding $10,000.

Against the foregoing is the fact that opportunity is rare for a mercantile or storage watchman to prevent any excess water damage. The N. F. P. A. records show 41 per cent of all fires at night (6 p. m. to 6 a. m.) or fewer fires in non-work hours than work hours. This, however, is because over ninety per cent of the N. F. P. A. fire record comprises factory occupancy.

For mercantile and pure storage taken separately, the night fires or non-work hour fires are somewhat the more frequent.[7] To illustrate—a watchman on twelve-hour watch, including Sunday, would be on duty for the hours during which about 56 per cent of the mercantile sprinkler fires occur.

But in mercantile and storage risks, the department stores have a work force all night; retail stores keep open some evenings or every evening; there is window dressing and floor scrubbing, etc.; so that the watchman is not a necessity for over three-fourths of the hours above mentioned or three-fourths of 56% of the fires, leaving 42%.

About one-third of these fires are shown by record to occur in non-storage basements, partitioned boiler rooms, chutes, etc.,[8] or where experience shows water damage to be nominal. Deducting one-third from 42% leaves 28%, and as the N. F. P. A. records show that the watchman fails on 10% of occasions a further reduction must be made to about 25%.

From the foregoing we conclude that in mercantile and warehouse risks the watchman is needed and likely to be of service at about every fourth sprinkler fire and (as earlier deduced) that the average saving by such service does not exceed $10,000. It will be noted that the N. F. P. A. records show about twelve factory fires for each mercantile or storage fire, and as the former are twice as numerous in the field it follows that sprinkler fires in mercantile and storage are one-sixth as frequent as for factory occupancy.[9] This means one fire per thirty risks per year, and as the watchman is effective on about every fourth fire, he is useful once a year in 120 risks. This at averages of value of risk and value of saving earlier stated shows the watchman to have about thirty dollars value per year per one hundred thousand dollars of mercantile or storage values.

Leaving the mercantile and storage occupancies and turning to manufacturing occupancy we find the night watchman more frequently needed and of less value when needed.

In factories the expectancy of "excess water damage," as found by experience and for damageable locations (along same lines earlier shown for mercantiles), does not exceed one per cent; or reckoning $200,000 as an average contents value for a sprinklered factory an average expectation not exceeding $2,000. On account of paper mills, flouring mills, glucose plants, cordage mills, printing offices, match factories, pottery kilns, saw mills, glass works and other industries operating wholly or partly at night,

[7] N. F. P. A. special advice August, 1913, shows a similar finding.
[8] N. F. P. A. special advice shows a similar finding.
[9] The frequency of factory sprinkler fires is deduced in footnote No. 10, below.

it will be found that about 70% of factory fires occur in work hours and about 30% at times when not manufacturing and in charge of a watchman. About sixty per cent of these fires occur in shaving vaults, boiler rooms, core rooms, smith shops, furnace rooms, at hot journals in wet departments, etc., and many other purely fortunate locations, leaving about twelve per cent in locations subject to any notable water damage. The watchman's failures and the sprinkler failures proper reduce the chances of real service from him to about every tenth fire, which at one sprinkler fire per year per five factories[10] or one real service per year in fifty risks (at averages of value at risk and value of saving earlier given) shows the watchman to have about twenty dollars value per year per one hundred thousand dollars of factory values.

The value of a night-watch for starting a fire pump is something for which the watchman should perhaps have money credit under the title of this paper, but such credit would be small. This is because mercantiles rarely have fire pumps and the same is nearly as true of many factories in cities and towns. The remaining sprinklered risks are a minority, and for these the primary supply usually controls the sprinkler fire without need to start a pump. The night watchman should also have credit for any water damage he may save due to accidental opening of a sprinkler, but such credit would necessarily be small because such cases are those of but one head and are very infrequent as compared to those of heads opened by fire.

As for the fires caused by watchmen, this paper is willing to assume that these are offset by smouldering fires he discovers and puts out unaided.

The Water-flow Signal.

The value of a water-flow signal as a sole reliance appears to be necessarily about ten per cent more to ten per cent less than that of a watchman.

The N. F. P. A. records credit the watchman with being 90% satisfactory, and various alarms at 85 to 95%, depending on up-keep. This the writer believes is fair.

If in lieu of a watchman, there should be a perfect alarm and the alarm should call perfect help, then the alarm would be ten per cent better than the watchman,[11] less any disadvantage (if any) due to delay.

In the same case, except to assume 90% efficiency of alarm and help responding of same grade as the average or 90% watchman, then the alarm would be ten per cent poorer than a watchman plus any disadvantage (if any) due to delay.

Thermostats.

A thermostat system appears worth a little less than a water-flow alarm, because it does not signal for accidental opening of a sprinkler; but,

[10]The N. F. P. A. records miss many small fires, but show a frequency of one fire per year per seven factories. Departments making close inspection miss fewer fires. Member W. A. Stoney advises one in five; Member E. V. French one in five or six, and some fires missed; Member W. D. Matthews one in eight, part mercantile; Member H. L. Phillips one in three, largely picker fires; Member Albert Blauvelt one in six and few picker fires; Members E. T. Cairns and F. J. McFadden send notes on frequency of "claims" tending to agree with other reports. Allowing for fires not reported, the writer believes one in five is a fair average over all territory and all factories.

[11]Member H. C. Henley claims to secure this efficiency or better, using an alarm of local design, with rigid up-keep, connected to Salvage Corps Station.

as before stated, such losses come to but little money when divided by all the risks in the field.

There is no ground therefore to deem any water-flow signal or any thermostat worth more than a very few dollars per year more or less than a watchman, per $100,000 at risk.

Combinations.

An alarm added to a watchman (who by N. F. P. A. records is 90 per cent satisfactory) can only call the watchman, and perhaps call other and perhaps better help, but cannot aid the sprinklers and can only reduce the ten per cent inefficiency of the watchman, a matter of two or three dollars yearly per $100,000 at risk. This explains why underwriting offices, both east and west, which make a specialty of factory risks having night watchmen, are able to carry many hundreds of million dollars at risk over many years with success at low rates and yet in a general way remain passive toward (or at least make no specific recognition of) any form of signal system.

Another point is the folly of assuming a choice between local and central-station signal systems. All that any signal can do is to call for help, and the utmost possible is that the call reach competent help. There is no virtue in a local alarm because it is local, nor in a central station alarm because it is central; all depends on the location of whatever help would be most likely to treat a sprinkler fire intelligently, and such best help may be public or private, central or local.

Supervisory Signals.

This is a separate idea (as from a water-flow signal), and has tank and valve signals intended in case of disorder to call a central station to notify the risk and secure restoration of service. The argument is that this supervision is constant as against inspections, which are periodical. A signal system cannot observe high stock piles, paper ceilings, obstruction of sprinklers, wasps' nests on sprinklers, corrosion of sprinklers, clogging of sprinklers, misuse of hard heads, lack of drainage, etc. In short, a signal has no judgment and no eyesight. No signal system can prevent interruptions due to air or water leaks; nor for repairs or alterations; nor because of (or in fear of) frozen pipes. No signal system appears able to indicate the position or disorder of indicator post valves, nor for gates controlling city water, nor can it test drains to discover internal obstructions. In short, as per N. F. P. A. records, tank and gate signals cannot possibly apply as against over one-sixth of "unsatisfactory" fires.

The printed loss records of sprinklered risks in western territory for eleven years, prior to 1909, show full details of one hundred and fifteen large losses all without benefit of supervisory service. Very little of these losses (being all exceeding $10,000) would have been saved by tank or valve signals. Tank and valve signals have been in the field long enough

and in sufficient number to be no longer entitled to a speculative valuation based on opinion or sentiment, and any money worth attachable thereto should be supported by reasonable evidence of losses averted where such signals are installed or which would reasonably have been averted had such signals been installed. The writer has made diligent inquiry, including search through original files of N. F. P. A. office, and finds the evidence of such saving to be so small as to be preferable not to quote.[12]

The N. F. P. A. sixteen-year record shows forty-four "unsatisfactory" mercantile and storage fires, nearly all without gate and valve signals. If we assume the full theoretical possibility of gate and valve signals, this would mean that seven or eight of these losses could have been saved. Nevertheless, such utmost theoretical saving, when divided by the number of risks and years, clearly proves that for risks having a supervisory water-flow signal and tank and valve signals it is impossible to theorise as much value for the tank and gate signals as for the water-flow signal.

In conclusion, the writer is confident that those men who keep track of specific fire-cost under sprinklers will see that this paper undertakes to deduce, from actual loss experience, what measure of increase of loss expectancy might reasonably be anticipated on a presumption of the presence in risks of no special man nor signal, with sole dependence on sprinklers during non-work hours.

It is believed the evidence presented is sufficient to demonstrate that $50 to $75 per year for factories, and $100 to $150 per year for mercantiles is sufficient to cover the entire money value of watchmen and signalling systems in connection with losses under automatic sprinklers for the average sprinklered property.

[12]Acknowledgment is due to the N. F. P. A. office, for research, and also for loan of files. The Ohio Inspection Bureau, Chicago Underwriters Association, Michigan Inspection Bureau, The Union, New England Insurance Exchange, Western Sprinklered Risk Association, Underwriters Bureau of the Middle and Southern States, and the Underwriters Association of the Middle Department were all consulted and sent data or information.

Cordage Fibres.

Their Physical Properties, Hazards and Characteristics.

By T. E. Sears (Member N. F. P. A.)

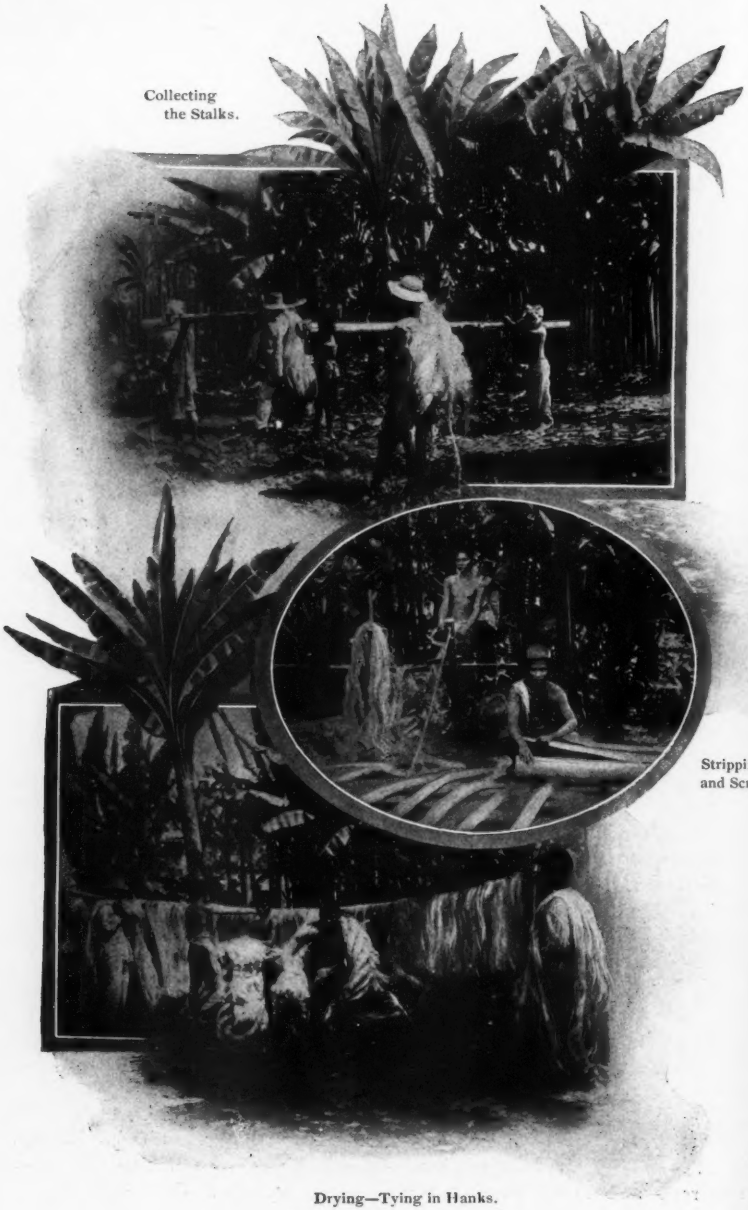
The fibres used in the cordage industry are numerous, and in the fibre literature of English-speaking countries no name appears more frequently than the word hemp. This name is applied indiscriminately to fibres differing widely from each other. So generally has the term been applied to fibrous substances that it is misleading without a prefix, such as *manila hemp*, *sisal hemp*, *sunn hemp* and scores of others that relate to entirely distinct kinds of fibres. Hemp without a prefix is generally understood to mean the fibres from the true hemp plant, *cannabis sativa*.

The basis of all vegetable fibres is to be found in cellulose, a compound belonging to a class of naturally occurring substances known as carbohydrates. The fibres may be either seed-hairs, such as the different varieties of cotton, cotton-silk, etc., or bast fibres, which include those obtained from the cambium layer of the dicotyledonous plants, such as flax, hemp, jute and ramie; or vascular fibres, which include those obtained chiefly from the leaf-tissues of the monocotyledonous plants.

Bast fibres consist of completely enclosed tubes, each end being pointed. Each individual fibre is multicellular, the cells being long and usually polygonal in cross section. The cell walls are usually rather thick, and the cross section instead of being flat and narrow is broad and more or less rounded. The entire wall is frequently covered with a thin layer of dried protoplasm, and in the case of common hemp the fibres are rich in parenchymous deposits attached to the fibres in a crystalized or star-shaped formation. One of the important characteristics of bast fibres is the occurrence of dislocations or joints throughout the length of the fibre, which occur particularly in hemp. The fibres may be identified not only by this characteristic, but also by the presence of foreign matter contained in the cell wall.

The vascular fibres, such as the agaves (sisal, etc.) aloe, pineapple fibre and cocoanut fibre, come from the leaves of these cocoanut-like plants, and are known by their hard, vessel-like formation. The cells of the fibre elements are long, and the fibre bundles are interlaced with a peculiar spiral formation.

From the standpoint of the underwriter, these fibres may be divided into two principal classes, hard and soft fibres. The hard fibres, by virtue of their construction, do not absorb water rapidly when immersed and do not heat or decompose as rapidly as do the soft fibres,



Filipinos Preparing Hemp.

which, when damaged, must be handled at once, if any salvage is to be expected.

Hard Fibres.

Manila	*Musa Textilis.*
Henequen, Sisal, Maguey, Mescal Maguey, Istle, Zapupe	*Agaves.*
New Zealand	*Phormium Tenax.*
Mauritius	*Furcraea Foetida.*
Cabuya	*Furcraea Cabuya.*

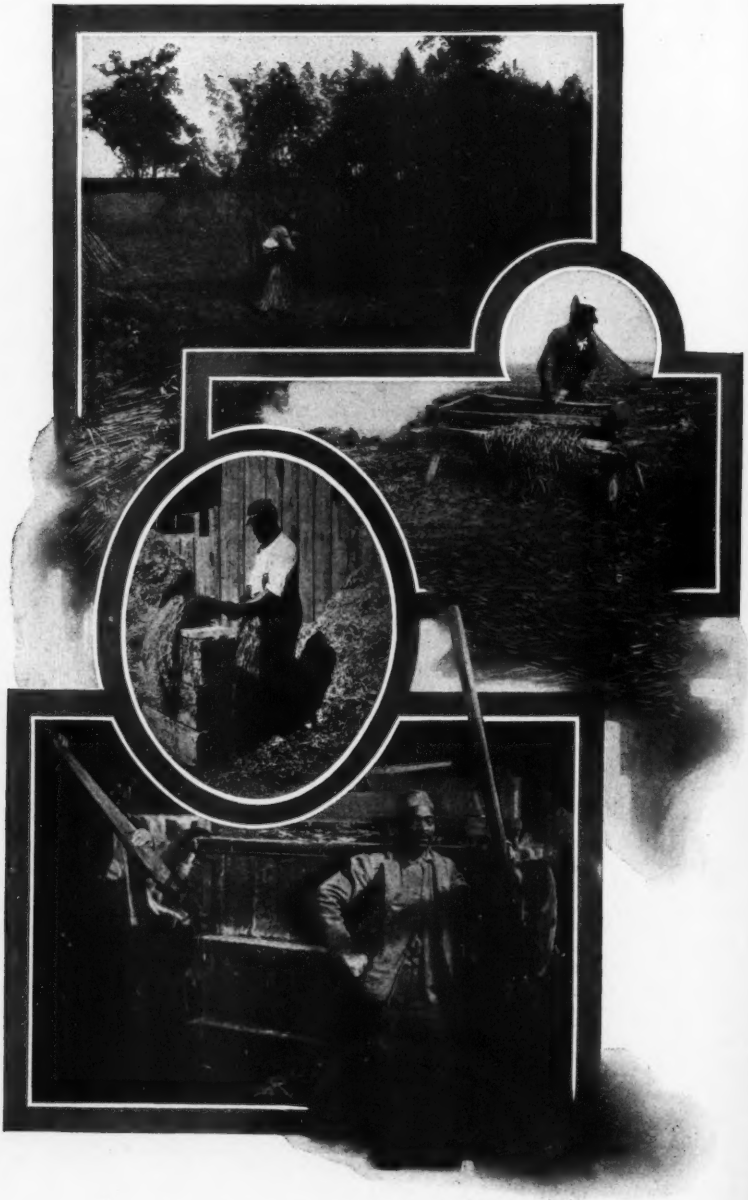
Soft Fibres.

Hemp — American, Italian, Russian	*Cannabis Sativa.*
Jute	*Corchorus Capsularis.*
Sunn	*Crotalaria Junces.*
Flax	*Linum Usitatussimum.*

Manila.

"Manila Hemp," frequently known to the trade as "Manila," and to the Filipinos as "Abaca," is obtained from a species of plantain botanically known as "musa textilis," growing principally in the Philippine Islands. Although numerous attempts have been made to grow this fibre-producing plant elsewhere, these efforts have been without commercial success. The plant will grow in any country where the banana is produced, but will not yield fibres suitable for cordage purposes unless grown in the Philippine Islands. Volcanic soils near the base of the mountains, sloping south and east, with good drainage, warm sunshine and freedom from high winds are essential for successful growth. In fact, these conditions are fulfilled only in the zone limited to that portion of the Philippines lying between seven and fourteen degrees from the Equator.

"Abaca," the name given the plant, as well as its fibre, grows wild throughout the district, but the difficulty in handling and the lack of uniformity of this plant make cultivation essential, and all the fibre now brought to market is from the cultivated plant. There is, however, still a considerable variety of species in the cultivated plant, but with the progress of this industry it is anticipated that certain specific species will soon be produced exclusive of all others. This plant closely resembles the banana plant in appearance, matures in from fifteen months to three years from planting, varies from six to twenty feet in height and from thirty to one hundred and thirty pounds in weight, and produces from one half to six pounds of dry fibre per plant. The plants are grown from shoots or suckers set in rows about eight feet apart and cultivated by hand or by mules. When the first shoots mature the harvest thereafter, in most



Cutting the Hemp—Breaking—Hackling—Baling.

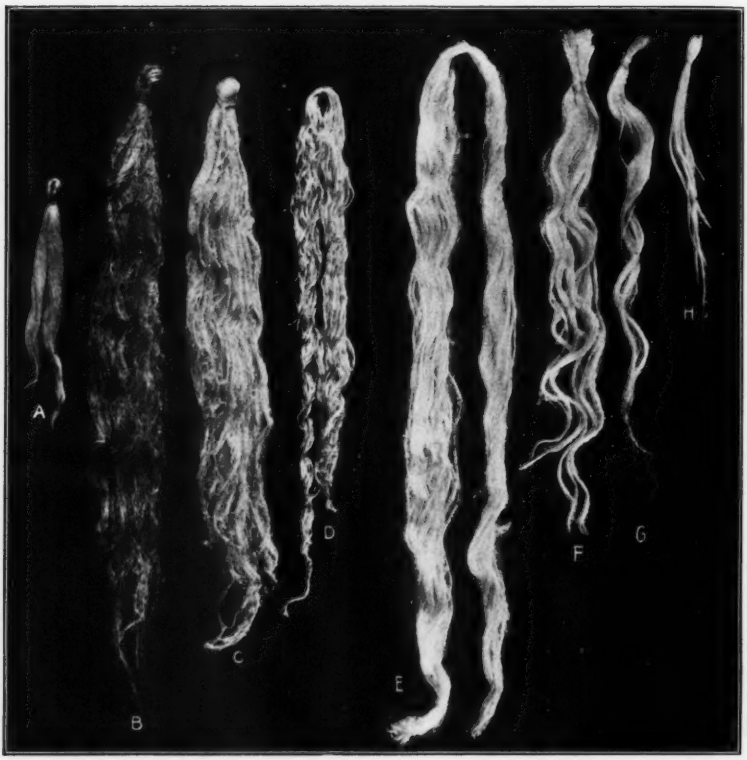
localities, is continuous, because new shoots are continuously springing from each root, making plants of all sizes.

In harvesting, the plant is cut down close to the ground and the top cut off where the leaves branch out. This trunk is composed of crescent-shaped sheaths running the full length of the plant and forming layers growing very closely around each other. The fibre is contained in the outer skin of each sheath, the inside of the crescent being composed of pulpy cellular matter saturated with moisture. The separation of the fibre from the sheath is obtained by hand strippers, by first breaking up the crescent formation and removing the pulpy matter from the inner portion, leaving a thin ribbon, which contains the cordage fibre and is known as the "tuxy." These tuxies are cleaned of all remaining foreign matter so that each fibre is separated from the other by drawing under a knife having a very smooth and keen edge. This knife, or in some cases a sharp piece of wood, is arranged so that considerable pressure may be exerted on the tuxies. The greater pressure and smoother knife edge gives the fibre a greater lustre and strength, as it relieves it of any foreign matter that in the drying process tends to discolor or weaken the fibres. After stripping, the fibre is hung out in the sun to dry on lines or racks.

Cleaning Manila Fibres.

The average hand stripper produces about twenty pounds of dry fibre each day, but the task is so exhausting that the laborer will not continue for any length of time. There is frequently a tendency on the part of the laborer to use knives with ragged edges and to exert only moderate pressure, allowing the sun to dry the pulpy matter for him. This process, however, makes a considerably inferior fibre. The more complete the separation of the fibres from each other and the more juice and pulp extracted in stripping, the brighter, whiter, stronger and more valuable the product.

As the hand strippers are invariably natives employed on the share system, one half of the product going to the stripper and the other half to the planter, there is a strong tendency on the part of the native to work only as the necessity of food and provisions requires. As a result, the supply of workmen is irregular and unreliable.



Soft Fibres. [A, Flax; B, Hemp, dew-retted; C, Hemp, water-retted; D, Jute.]

Hard Fibres. [E, Manila; F, Sisal; G, Mauritius; H, Istle.]

On account of the numerous species and particularly on account of the crude methods of cleaning the fibre, it is very difficult to divide it into a few standard varieties. Frequently the middlemen who purchase the fibre grade it into as many as fifteen different varieties. In the storehouse at Manila it is graded into three or four grades, packed into bales of approximately 275 pounds, and in this condition reaches the manufacturers. Owing to the great variety of grades and regrading process, there has been a considerable increase in prices from the planter to the consumer. The only apparent way to overcome this difficulty is by the use of machinery, and although large sums of money have been expended in an effort to secure a machine that could handle this matter as satisfactorily as the machines for handling sisal, no great success had rewarded these efforts up to the time of the American occupation of the

Flax grown for fibre at Northfield, Minn., ready for harvest.

Hemp on alluvial soil at Gridley, California.

Philippines. Since then, however, a number of machines have been placed in operation that have shown fair results, and it is not unlikely that in the near future a machine will be in universal use that will produce not only a more satisfactory fibre for the manufacturers but a cheaper product as well.

The best grade of manila is of a light color, lustrous and very strong, in firm, even strands six to twelve feet long. Poorer grades are considerably duller in color, some of them yellow or even dark brown. The better grades are regarded as the only satisfactory material available for making hawsers, ship cables, and other marine cordage which may be exposed to salt water, or for well-drilling cables, hoisting ropes and transmission ropes to be used where great strength and flexibility are required.

The best grade of binder twine is made of manila fibre, since, owing to its strength, it can be made up with 25 per cent more length per pound than sisal, the fibre next in importance to manila in this industry.

Henequen (*Agave fourcroydes*).

Henequen is a native plant of Mexico and has long been known in the trade as sisal, because it was formerly shipped from the port of Sisal in Yucatan. It belongs to the same botanical family as the true sisal, but it is not so smooth nor so pliable, nor so strong as *Agave sisalana*, and does not bring as good a price in the market. It is, however, admirably adapted for the manufacture of binder twine and ropes of various kinds, and it is for this purpose that most of the henequen produced is used.

The plant requires a hot, dry climate, and although it grows in many tropical countries, it is cultivated for fibre production principally in Mexico. The state of Yucatan is the principal country of production, and Merida, the capital of the state, the chief market, and Progresso the principal seaport from which the fibre is exported. The soil and atmospheric conditions of this territory are admirably adapted to the growth of henequen, and the many large farms or haciendas that have developed in the state have made fortunes for their owners.

The methods of propagation and harvest are the same as for sisal (*Agave sisalana*). The *Agave sisalana*, however, matures somewhat quicker and does not live so long. The first crop of leaves from the henequen is cut usually the sixth or seventh year in Yucatan, and after that crops are obtained from ten to twenty years. The harvesting and fibre preparation is accomplished in the same manner as outlined for the true sisal. There is, however, one marked point of difference between the leaves of these two types. The henequen leaves are somewhat shorter and have spines on their edges and a thorn at the point which must be trimmed off before the plant reaches the mill, while the leaves of the true sisal are without spines on their edges and the length is about a foot greater than the length of the henequen leaf.

Henequen is yellowish white, with sometimes a greenish tinge. It lacks, however, the gloss, brilliancy and strength which is characteristic

Cutting Leaves.

Trimming off Thorns.

Sisal Culture.

of manila. While manila is noted for its smoothness and pliability, sisal is quite the reverse, being comparatively less flexible and much more harsh. The presence of splinters in so-called manila rope indicates the use of henequen as an adulterant. These less favorable characteristics of

the henequen are not so prominent in the true sisal. On the other hand, the henequen fibre is especially adapted for the manufacture of a rope or yarn for tying purposes where it is used as a band and then discarded, as it is of sufficient strength and can be spun with a fair degree of smoothness. It may be readily treated with tar, which is an advantage when the material upon which it is to be used is stored out of doors.

The greatest use made of this fibre is in the making of binder twine for the self-binding reapers, the rise of which has added tremendously to the wealth of Yucatan and to those American states where this raw material is made into the finished product.

Sisal.

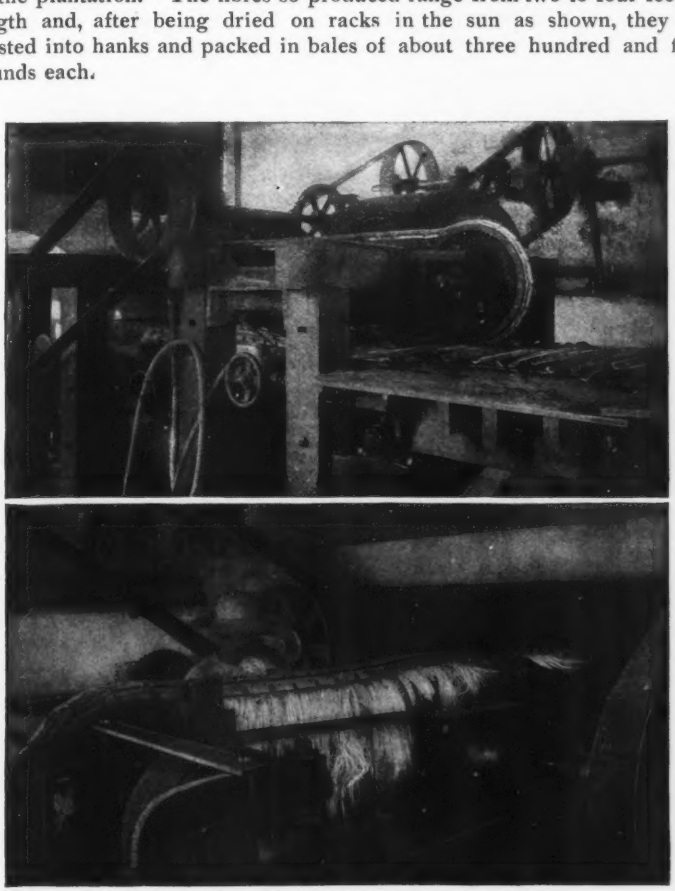
The true sisal is taken from the leaves of the sisal plant (*Agave sisalana*), a native of Central America and cultivated for fibre production in the Bahamas, Hawaii and Africa. This is closely related to henequen (*Agave fourcroydes*), which is grown chiefly in Mexico for commercial production of fibre.

Sisal Drying.

The true sisal, however, when properly prepared, is superior to henequen and brings a better price in the market. At the present time it is being imported in large quantities from Africa, and used for the manufacture of various grades of ropes and to a great extent for binder twine. Although the plant will endure slight frosts and considerable variation in soil and moisture conditions, it can be most profitably produced in dry soil and where the temperature does not fall below freezing. It is propagated in the same manner as henequen, from shoots or suckers, and set out in rows about nine feet apart and about six feet apart in a row. Cultivation is by hand or machinery, although in many cases no attempt is made to stir the soil after the first year and vegetation is kept down by the use of machetes.

The first leaves mature from three to five years after transplanting and crops are then obtained semi-annually or annually for from five to ten years. The leaves nearest the base are harvested first and when they assume nearly horizontal positions indicate that they are ready for cutting. The fibre is obtained by special machinery located in the cleaner house

on the plantation. The fibres so produced range from two to four feet in length and, after being dried on racks in the sun as shown, they are twisted into hanks and packed in bales of about three hundred and fifty pounds each.



. Leaves Going In—Cleaned Fibre Coming Out of Cleaning Machine (Sisal).

Maguey (*Agave cantala*).

Maguey is a comparatively new fibre on the market, and is produced from the leaves of the maguey plant, which very closely resembles the henequen of Yucatan. The plant is now cultivated on a commercial scale in the Philippines and Java, as well as portions of Africa. It is there cultivated on large plantations similar to those in Yucatan, and its fibre is obtained by the same kind of machines. In some instances the fibre is prepared by hand, but the quality in such cases is injured by soaking the leaves in water to facilitate the work of hand cleaning. The

fibre, when properly cleaned, is whiter, finer and more flexible than henequen, and is used to a limited extent for the manufacture of binder twine, chiefly for mixing with other fibres, and it is probable that with development it will be more extensively used in the future.

Mescal Maguey.

Mescal maguey is a fibre similar to henequen, but finer and softer, and is produced in the state of Sinalo in Western Mexico from the leaves of the mescal maguey plant, one of the agave species.

This plant is cultivated primarily for the production of the strong alcoholic drink "mescal," distilled from its base. The habits of growth and methods of cultivation and preparation are very similar to those of sisal and henequen. The fibre is used chiefly in the cordage and twine mills on the Pacific Coast.

Istle.

The fibre of this plant, heretofore used principally in the manufacture of brushes, is now being used to a limited extent as a substitute for the cheaper grades of twines and cordage. The fibre is shorter than that of the henequen plan and at present is prepared generally by hand. With improved methods of preparation this fibre may become more of a factor. Istle or Tampico is produced from four or five species of plants related to the Agave family which grow on the high arid table lands of Northern Mexico. The grades most used by the manufacturer are known to the trade as Palma, Tula and Jaumauve.

Zapupe.

In Eastern Mexico, in the states of Tamaulipas and Vera Cruz, three agaves which are not produced to any great extent, known respectively as "zapupe azul," or blue zapupe (Agave zapupe), "zapupe de Tepetzintla" (Agave lespinassei), and "zapupe verde" (Agave deweyana) are cultivated. These plants grow well on loamy soils with more moisture and less lime than seem necessary for good results with henequen or sisal. Otherwise they are cultivated in much the same manner and the fibre is cleaned by the same kind of machine. The fibre from these three different species differs somewhat, but it is all softer and finer than henequen.

New Zealand Flax (*Phormium tenax*).

New Zealand flax, sometimes called hemp, is not at all like either hemp or flax, but is obtained from the leaves of the *phormium tenax*, a native plant of New Zealand. This plan grows in a semi-wild state when the land is cleared of other vegetation, not being cultivated systematically for fibre production.

This is the most important hard fibre plant outside of the tropics, and grows in moist, rich land and swamps, often in large clumps. The leaves are from five to ten feet long, about two inches wide and one-sixteenth of an inch thick, with a firm texture and a hard surface, making it difficult to scrape off the pulp without injuring the fibre.

The fibre is prepared by beating and soaking in water, scraping, drying, beating a second time, sorting and baling. The fibre is approximately four to eight feet long and of a reddish yellow color, and although finer and softer than *abaca*, is much weaker. It, however, resembles *abaca* more than any other fibre and may be mixed with it in spinning, but does not have sufficient strength to be used in the higher grade ropes.

New Zealand Flax.

Mauritius.

Mauritius is a hard fibre obtained from the botanical plant *Fourcraea foetida*, in the island of Mauritius. It is white in color and more flexible than henequen or *abaca*. Although a native of Eastern Brazil, it is cultivated for fibre production principally in Mauritius.

The plant grows like sisal, but has larger leaves, measuring from four to eight feet long and six to eight inches wide. Like New Zealand fibre, it must be prepared by beating, scraping and washing. The method of preparation is quite laborious, but produces a very white, flexible fibre, very useful in mixing with other fibres to make the color of the rope or twine. Like New Zealand, however, it is not so strong as *sisal* or *abaca*.

The difficulty in preparation is largely responsible for the poor quality of much of the fibre that reaches this country; with the use of improved machinery a better fibre may be produced and mauritius may be more generally used.

Cabuya (*Fourcraea cabuya*).

Cabuya fibre, produced to a limited extent in Costa Rica, occasionally quoted as "Central American Sisal," may be used for binder twine. Thus far it has been cleaned principally by hand and an inferior fibre produced. When properly prepared, it is larger and stronger than the henequen fibres.

Hemp.

Hemp, *Cannabis sativa*, is an annual plant of the mulberry family, cultivated for the production of a soft bast fibre. In a strict sense the name "hemp" is correctly applied only to this plant and its fibre. It is a native of Asia and is cultivated commercially in countries in Europe, China, Japan and in America. Russia produces for export more than all the other countries; but Italy (and possibly France), owing to conditions of climate and methods of preparation, supply a finer, lighter-colored and stronger fibre than the other countries.

Hemp requires about 110 days for its growth, and is cut either by hand or special machinery. The hemp stalks are dried, set in shooks and sometimes bundled and stacked. Later the shooks or stacks are opened and the hemp again spread out for exposure to action of the dew, frost and sun, which dissolves the gums holding the filaments together and makes the inner woody stem dry and causes it to fall away readily when passed through the breaker. Superior fibre is produced by water-retting, but owing to the expense involved, practically all the hemp produced in this country is dew-retted.

The old-fashioned hand-break is still used in many localities, but, owing to the difficulty in securing sufficiently skilled labor, machines are replacing this method of breaking the hemp and preparing the fibre.

At one time the cultivation of hemp formed an industry of considerable magnitude in Kentucky, but, owing to the development of manila and other fibres and changing conditions, hemp is used comparatively little in the manufacture of cordage to-day and is grown only in limited quantities in this country. Years ago American hemp went into the rigging of both merchantmen and men-of-war and was a source of national pride, but the substitution of steam vessels for sail and the use of other fibres and of wire for rigging have taken away the great field of usefulness once open to American hemp. It is used in commerce to-day for making carpet yarns, grey twines and various tarred goods such as ratline, marlin, house line and other minor products.

Jute.

Jute, the most commonly cultivated of which is *corchorus capsularis* and *corchorus oblitorius*, is a bast fibre obtained from the various species of corchorus, growing principally in India and to a lesser extent in China and Japan. The plants are annuals and the habits of growth and process of cultivation are very similar to that employed for *Hemp*. The plants attain a height of eight to twelve feet and grow best in rich, alluvial soil along the rivers.

The plants are also harvested in the same manner as hemp, although practically all of the jute is water-retted. The best grades are obtained by retting in clear running water, but the retting is much quicker accomplished by soaking the fibres in stagnant water, a much darker and coarser fibre being obtained by the latter process. After a few days the bast becomes disinte-

grated and the retted stalks are pressed and scutched. The fibre has a length of from four to seven feet, and is fine, soft, glossy and easily spun.

The coarser fibre from the base of the stalk, from five to twenty-five inches in length, is cut off and placed on the market as jute butts, which are often employed as a material for making so-called linen paper.

Jute, owing to exposure, changes from a creamy white to a dingy yellow color and loses strength, especially if exposed to moisture. It is the cheapest fibre used in American textile manufacture and is employed in greater quantities than any other except cotton and sisal. It is not, however, used for the manufacture of rope, except in some cases as an adulterant. As a general proposition it is disastrous to use jute in high priced rope, as the weakening effect produced with much exposure is very serious. It can be used safely, however, where no great tensile strength is required and in the manufacture of goods not exposed to moisture. It is used principally for the manufacture of rugs, carpets, grain sacks and to some extent for binding twine of various descriptions.

There has been a tendency during recent years, owing to the high prices of the high grade fibres, to substitute jute for the better fibres. This is certain to work injury to the trade, because twines and cords made from jute will not hold their strength and will not prove satisfactory to the consumer.

Sunn Hemp (*Crotalaria juncea*).

Sunn hemp is a bast fibre from an annual plant, and is also known by the names *Conkanee*, *Indian*, *Brown*, *and Madras hemp*. It is grown in southern Asia and has been used in the manufacture of cordage during the past two years in increasing quantities. Most of the fibre is of a grayish color, similar to the Kentucky dew-retted hemp. It is rather poorly prepared; however, and in quality, irrespective of its preparation, it is more nearly like *jute*. The fibre is obtained from the plant by retting, and when prepared is somewhat stronger than *Kentucky hemp*.

Flax.

Flax (*linum usitatissimum*) is a native of western Asia, and doubtless one of the earliest plants cultivated for fibre, and until cotton was first produced commercially was used more extensively than any other vegetable fibre.

Flax is, however, used more in the manufacture of linen sewing thread, shoe thread, bookbinders thread, fishing lines, seine twine, and the better grades of wrapping twine and knit underwear, and for weaving into handkerchiefs, toweling, table linen, collars and cuffs, shirts, and dress goods, and can be considered as a cordage fiber only as it applies to the manufacture of wrapping twine and the manufacture of binder twine from the flax straw.

Flax straw is broken, scutched, and partly hackled and then mixed with a small percentage of hard fibre to give it added strength and rigidity

and in this form is passed through the various cordage machinery, and finally delivered in the form of binder twine ready for the harvest.

Tests.

Recent tests made by Mr. M. F. Jones, Chemical Engineer of the New England Bureau of United Inspection, illustrate the comparative liability of hard and soft fibres to spontaneous ignition, their tendency toward absorption and the comparative ignition and smouldering qualities of the two grades of fibres.

These tests were made with samples of coarse and fine manila, sisal, New Zealand, jute and cotton, by employing the Mackey Cloth Oil Tester and linseed oil to determine the tendency toward spontaneous combustion. The various specimens of hard fibre reached, in three hours, a temperature between 226° and 260° Fahrenheit, and all then fell back to approximately 220° in two hours. Jute reached 424° in two hours and cotton batting 520° in one hour and thirty-five minutes. Cotton was used in all these tests for comparison only.

Tests for ignition resulted as follows:

Manila (Fine)	520° F.
" (Coarse)	533° F.
Sisal	580° F.
New Zealand	615° F.
Jute	568° F.
Cotton Batting	665° F.

Smouldering tests were made by taking bundles of these various fibres and winding each spirally with fine copper wire, forming rolls about $\frac{3}{8}''$ in diameter and 5″ long. Each roll was thoroughly ignited and while the cotton and jute fibres were entirely consumed, not more than $\frac{5}{16}''$ was burned from the hard fibre specimens.

The tendency of absorption was determined by dipping in a solution of aniline acid. With the soft fibres, the brightest part appeared to be in the centre. The hard fibres were split after coloring and the microscope showed the outer surface to be bright red, while the inner surface showed very little color, indicating only slight absorption.

Exposure to a heat of 300° is destructive to all hemp fibre, while less so to cotton fibres.

While these tests, like all laboratory tests of this nature, cannot indicate positively that identical results will occur in large masses of these materials, under conditions met with in mills and storehouses, they may, however, serve as a guide in forming an opinion as to the comparative characteristics of the materials, as regards their fire hazard, and in the analysis of actual losses.

Reviewing the record of large fire losses, it is evident that these losses will occur in storehouses, as the quantity of fibre distributed about the factory is limited as compared with that in storage. The fibre fires show that while the causes are too varied to classify, it is doubtful if any loss has been

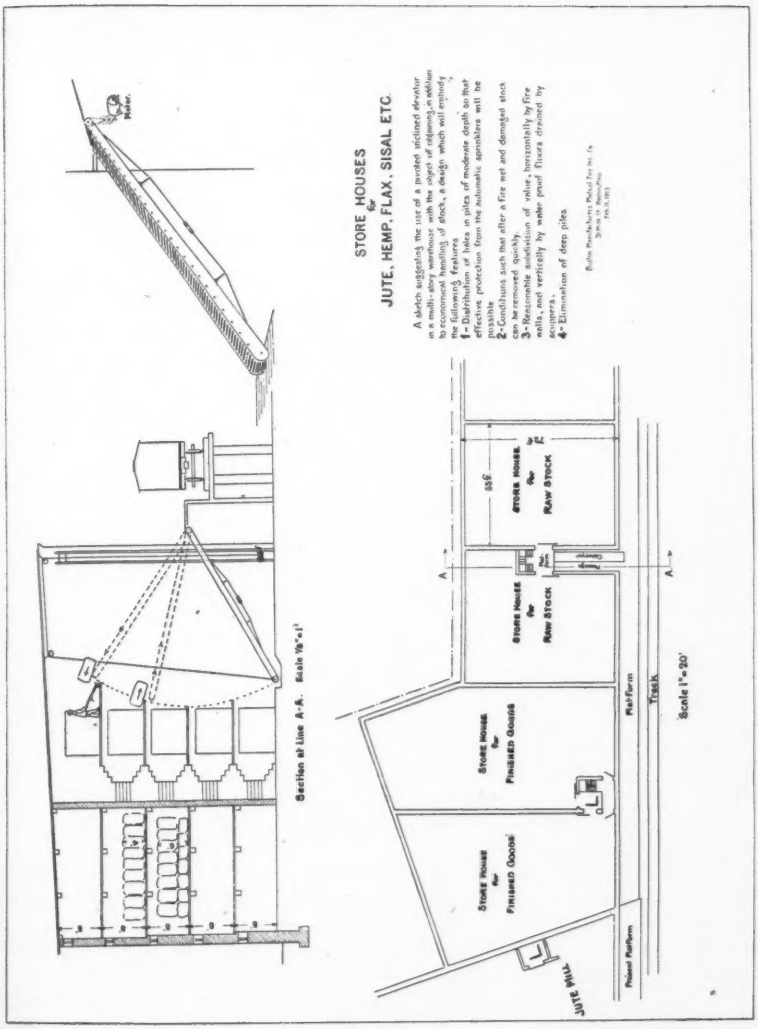

STORE HOUSES
for
JUTE, HEMP, FLAX, SISAL ETC.
A sketch suggesting the use of a pivoted inclined elevator on a multi-story warehouse with the object of obtaining, in addition to economical handling of stock, a design which will embody the following features
1- Distribution of loads on piles of moderate depth, so that effective protection from the automatic sprinklers will be possible
2- Conditions such that after a fire wet and damaged stock can be removed quickly.
3- Reasonable subdivision of value, horizontally by fire walls, and vertically by water proof floors cleaned by scuppers.
4- Elimination of deep piles.
Section at Line A-A. Scale 1/8"=1'
STORE HOUSE for RAW STOCK
STORE HOUSE for FINISHED GOODS
JUTE MILL
Platform
Track
Scale 1"=20'

Figure 1.

directly traced to the spontaneous combustion of hard fibres, and it is stated by some authorities that they have no satisfactory proof that soft fibres have spontaneously ignited. With the largest losses, a not infrequent phenomenon is the collapse of the building walls, due to the swelling and expansion of the fibre from the excessive absorption of water. Results show that

swelling and expansion are far more serious with the softer than with the hard fibres; in fact, there appears to be no record that the swelling of hard fibres has ever been sufficient to collapse the walls of the containing building. Experience, however, shows that in the case of soft fibres, and more particularly in the case of jute and "jute butts" (the production of this fibre is greater than that of all the other soft fibres combined) the salvage is low and often nothing at all, unless the material is handled immediately after the fire. Large masses of this fibre, when wet, heat rapidly and soon decay, and, unless steps are taken at once, very little or no salvage can be effected. Hemp, having a higher price than jute, will show somewhat better salvage results, but must be opened and dried at once or heating and decomposition will set in. The tendency toward rapid decomposition is due, not only to the soft nature of these bast fibres, but to the covering of dried protoplasm and parenchymous deposits attached to the fibres in crystallized form which, under immersion, soften and soon cause decay.

In salvage all fibres are handled in practically the same manner; the bales are opened and the various hanks spread out in thin layers on racks or platforms built for this special purpose, to allow the sun and wind to dry them quickly. When very large quantities must be handled, it is often necessary to spread the fibre on the ground and treat in much the same manner as hay is made, but such treatment does not produce so satisfactory results as when dried on the special racks. It is possible, however, to use these frames and platforms only for limited quantities, and where a loss involves large values, the salvage is consequently less.

Hard fibres, and particularly manila (the most important of this class) will stand saturation for about two weeks, and there are cases on record where manila has been soaked with sea water for several weeks and still shown good salvage results. This is due to the high price of the various grades, as well as their capacity to resist absorption. In the case of sisal and other members of the agave family, the salvage is not so good as obtained from manila, owing to its lower price and tendency to discolor. These fibres, being of a clear whitish yellow, are easily stained by water, but as they may be used to good advantage for tarred goods, a satisfactory salvage may be secured.

As a general proposition, when hard and soft fibres are damaged under like conditions and the bales opened and dried soon after immersion, the salvage of the hard fibre should be between 55% and 65% and soft fibre between 30% and 40%. Unless, however, soft fibres are handled within a few days, the salvage will be much less, while with hard fibres the salvage will be constant up to one or two weeks, and in the case of manila fibre somewhat longer, and then recede, depending on conditions.

Evolution of Storehouse Construction and Protection.

With the growth of the cordage industry and the serious fires occurring to fibre storehouses, more and more care has been given to proper construction and protection.

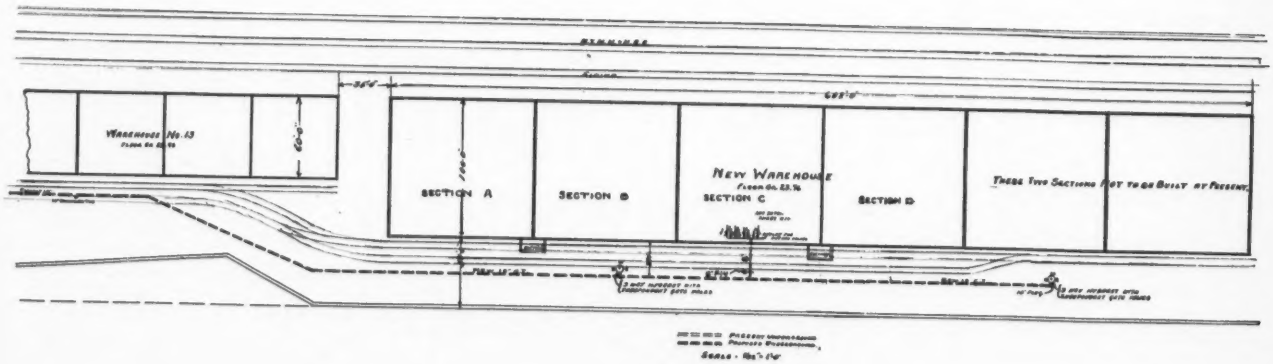
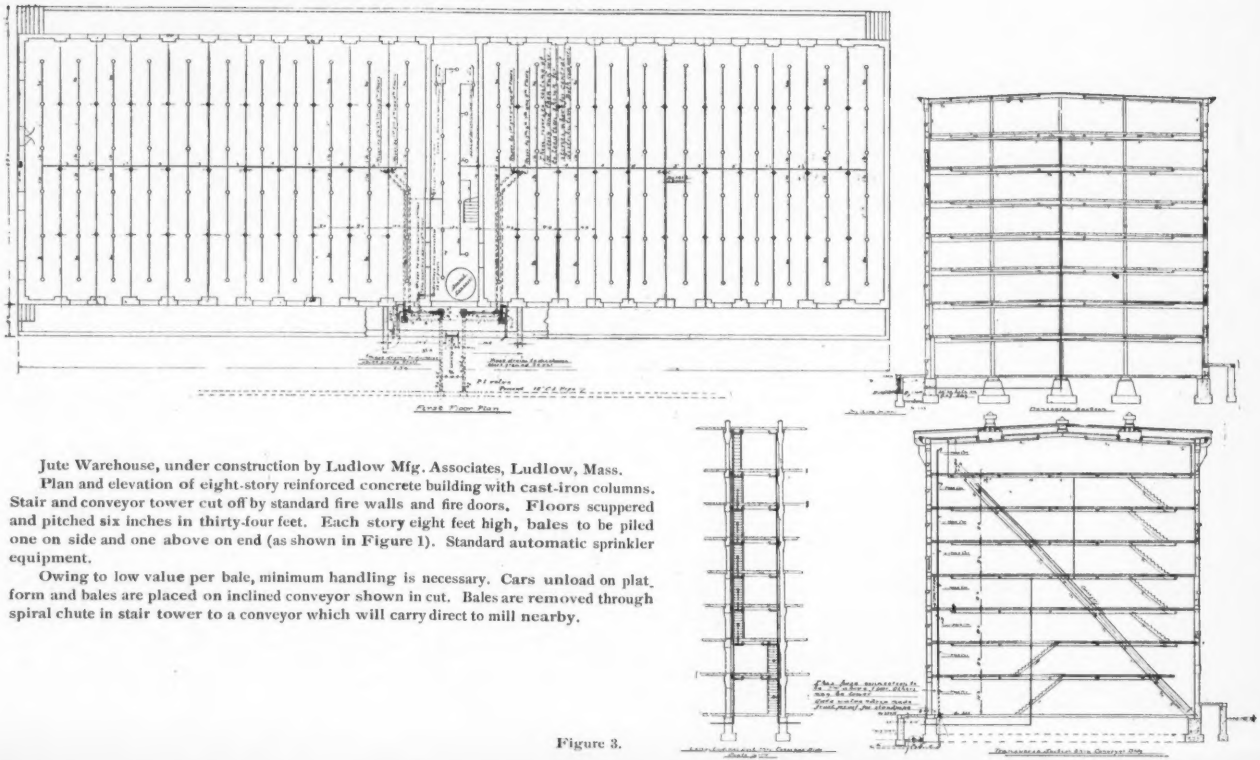


Figure 2.

Fibre and Finish Stock Warehouse, under construction by Plymouth Cordage Co., North Plymouth, Mass.

Plan of four-story reinforced concrete Warehouse divided by standard fire walls into four equal sections each 100 x 100 feet. Floors scuppered and pitched to carry off water. Standard automatic sprinkler equipment. Bales of fibre handled on cars and cars raised by standard elevator in tower cut off from main building.



Jute Warehouse, under construction by Ludlow Mfg. Associates, Ludlow, Mass.

Plan and elevation of eight-story reinforced concrete building with cast-iron columns. Stair and conveyor tower cut off by standard fire walls and fire doors. Floors scuppered and pitched six inches in thirty-four feet. Each story eight feet high, bales to be piled one on side and one above on end (as shown in Figure 1). Standard automatic sprinkler equipment.

Owing to low value per bale, minimum handling is necessary. Cars unload on platform and bales are placed on inclined conveyor shown in cut. Bales are removed through spiral chute in stair tower to a conveyor which will carry direct to mill nearby.

Figure 3.

In the early days most any waterproof shelter was considered adequate for storage purposes, and for convenience frequently large, single story, light constructed, frame buildings were erected with walls thirty to forty feet high. Into these storehouses were closely packed baled fibres with a total value frequently approaching a million dollars.

These buildings were without protection except from hydrants in the mill yard and such public protection as might be available. With the development of the automatic sprinkler, these buildings were ultimately equipped with this protective apparatus. Further experience, however, proved it impossible for sprinklers to extinguish fires in large masses of fibres, owing to the impossibility of the water reaching the source of the fire. Where the storage is many bales deep the fire travels between the bales where it cannot be reached by the water and may spread from one end of the building to the other. Even with hose streams it is difficult to extinguish fires of this character, and not infrequently the losses have been total or nearly so, as the large quantity of fibre wet and the wreck of the building, either from fire or collapse, have delayed salvage operations so long that little has been saved.

The evolution of the storehouse has resulted in the adoption of a mill-constructed or fireproof building of moderate area and height, equipped with a standard automatic sprinkler equipment and cut off from adjoining property by standard fire walls. The bales are piled with frequent passages between to assist in fighting fire and to allow for serious expansion.

The construction of a long row of storehouses, while of advantage to the Underwriter, prevents the economic handling of the raw material. With large manufacturers storehouses built somewhat along the lines suggested by Mr. G. S. Towers, Engineer of the Boston Manufacturers Mutual Fire Insurance Company, are now being erected at a number of large cordage plants.

This contemplates a brick, mill construction, or fireproof structure, with five or six stories each of such height as to accommodate two or three bales piled either on end or side as convenience may require. Stored in this manner, the automatic sprinkler protection will be effective. The bales may be handled quickly and the ground area necessary for the building is limited.

Extinguishing Fires in Lacquer with Sawdust.

By Factory Mutual Laboratories (Member N. F. P. A.)

These experiments were undertaken after learning that similar experiments had been conducted at a large manufacturing plant on the extinguishing of fires in burning lacquer by means of sawdust, and that the results had been very satisfactory.

The low cost of the material used. its simplicity, which makes its use more nearly resemble the fire pail than anything that has been previously suggested, the entire absence of any automatic device likely to fail to work at time of fire, and the fact that no special training would be necessary to enable the operatives to efficiently use the sawdust, seemed to justify careful consideration of the subject before it was dismissed. The plant very kindly consented to repeat the tests in the presence of a representative of the Factory Mutual Laboratories, and four tests were conducted in the yard. Two were in tanks 37 inches long, 14 inches wide and 16 inches deep, containing about two inches of lacquer; one in lacquer on a wooden floor and one in lacquer on the ground. The fires in the first three were readily extinguished with sawdust and the fourth was extinguished with sand, although requiring a longer time than the sawdust when applied to the lacquer on the wood.

Although these tests were entirely satisfactory, the proposition of putting out fires with a combustible material, such as sawdust, seemed to be so unusual that it was felt desirable to conduct a more extended series of tests. Especially was it desired to learn the effect of varying the size of the tank, the depth of the lacquer and the kind of lacquer.

Three tanks were accordingly obtained, built of sheet steel reinforced with angle irons. The largest was made 60 inches long, 30 inches wide and 16 inches deep; the middle tank 48 inches long, 14 inches wide and 16 inches deep, and the smallest 30 inches long, 12 inches wide and 16 inches deep. The joints were made tight with silicate of soda cement. Sawdust was obtained from a local saw mill, both soft and hard wood. The soft wood sawdust was probably a mixture of pine and spruce, and the hard wood apparently mostly oak. One barrel of sawdust was thoroughly dried to note the effect, if any, of moisture. It was thought possible that if sodium carbonate were mixed with the sawdust, the formation of carbon dioxide resulting from decomposition of the bicarbonate by heat might be of help in extinguishing the fire. A bushel of soft wood sawdust was accordingly mixed with ten pounds of commercial bicarbonate of soda and used in the cases mentioned below. An ample supply of sand was also provided.

Commercial lacquer as used in two plants was obtained. Nothing definite is known regarding the composition of these lacquers, but from their general appearance and odor, it is quite certain that they both were amyl acetate-pyroxylin lacquers thinned with the usual thinners, such as wood alcohol, benzine, etc.

The tanks used in the tests were placed out in the open, well away from any buildings. The weather conditions were fair, although the sky was overcast. The wind blew from the northwest at a velocity of from fourteen to nineteen miles per hour.

The sawdust was applied by means of a snow shovel having a steel blade 11 inches wide and 15 inches long, and provided with a handle 4 feet long. The following log of tests has been transcribed from notes taken at the time.

Log of Tests.

Test No. 1.—Small tank containing 2″ of No. 1 lacquer.

Time.	Remarks.
2:20:00	Fire started.
2:21:03	Sawdust applied.
2:21:28	Fire extinguished with 2½ shovels of soft wood sawdust in 25 seconds.

Test No. 2.—Small tank containing 6″ of No. 1 lacquer.

Time.	Remarks.
2:35:00	Fire started.
2:37:17	Sawdust applied.
2:39:29⅘	Fire extinguished with 2 shovels of soft wood sawdust in 12⅘ seconds.

Test No. 3.—Small tank containing 5″ of No. 1 lacquer left from previous tests after sawdust had been removed from the surface.

Time.	Remarks.
2:40:00	Fire started.
2:41:18	Sawdust applied.
2:41:53	Fire extinguished with 2 shovels of dry soft sawdust in 35 seconds. In this test some of the lacquer which had leaked out onto the ground ignited near the tank, but was readily extinguished with a small amount of sawdust in about 10 seconds.

Test No. 4.—Small tank containing 4″ of lacquer left from the previous tests after sawdust had been removed from the surface.

Time.	Remarks.
2:50:00	Fire started.
2:51:19	Sawdust applied.
2:51:29	Fire extinguished with ¼ shovel of mixture of bicarbonate of soda and sawdust in 10 seconds.

Test No. 5.—Same conditions as in Test No. 4 repeated.

Time.	Remarks.
2:55:00	Fire started.
2:56:03	Sawdust applied.
2:56:11	Fire extinguished with ⅛ shovel of mixture of bicarbonate of soda and sawdust, in 8 seconds.

Test No. 6.—Small tank with 3″ of No. 1 lacquer left from previous tests, after sawdust had been removed from the surface.

Time.	Remarks.
2:58:00	Fire started.
2:59:03	Sand applied.
3:00:58	Fire extinguished with 9 shovels of dry sand in 1 minute 55 seconds. The tank was over half full of sand before the last flame disappeared.

Test No. 7.—Middle tank, containing 2″ of No. 2 lacquer.

Time.	Remarks.
3:15:00	Fire started.
3:17:02	Sawdust applied.
3:17:13	Fire extinguished with 2 shovels soft wood sawdust, in 11 seconds.

Test No. 8.—Middle tank containing 1¾″ of No. 2 lacquer from previous tests after sawdust had been removed from the surface.

Time.	Remarks.
3:20:00	Fire started.
3:21:08	Sawdust applied.
3:21:17	Fire extinguished with one shovel of mixture of bicarbonate of soda and sawdust in 9 seconds.

Test No. 9.—Soft pine platform 5′ 2″ square provided with rim raised 2″ on all four sides. About two gallons of No. 2 lacquer uniformly spread over the surface.

Time.	Remarks.
3:30:00	Fire started.
3:30:45	Sawdust applied.
3:31:38	Fire extinguished with 3 shovels of soft wood sawdust in 53 seconds.

Test No. 10.—Same platform as in Test No. 9, with about 2 gallons of No. 2 lacquer spread over the surface.

Time.	Remarks.
3:35:00	Fire started.
3:35:36	Extinguisher applied.
3:36:32	Fire extinguished by means of a 3-gallon chemical extinguisher, but with some difficulty, in 56 seconds. In this test if the stream from the extinguisher had not been carefully sprayed, or if the platform had not been provided with a rim, it is probable that the force of the stream would have spread the lacquer all over the ground.

Test No. 11.—Middle tank containing 1⅜″ of No. 2 lacquer from Test No. 8, after sawdust had been removed from the surface.

Time.	Remarks.
3:40:00	Fire started.
3:41:32	Sawdust applied.
3:41:45	Fire extinguished with 2 shovels of hard wood sawdust in 13 seconds.

Test No. 12.—Middle tank containing a small amount of mixture of lacquer and sawdust from previous tests.

Time.	Remarks.
3:50:00	Fire started.
3:50:40	An attempt was made to extinguish the fire by placing the platform used in Tests Nos. 9 and 10 over the top of the tank. After what appeared to be a sufficient time had elapsed, the platform was lifted, but the

fire was still burning in the tank. Finally the platform caught on fire and was removed. The fire in the tank was extinguished with a small quantity of the mixture of sawdust and bicarbonate of soda.

Test No. 13.—Small tank containing 1¾″ of motor gasoline.

Time.	Remarks.
4:20:00	Fire started.
4:20:38	Sawdust applied.
4:20:50	Fire extinguished with 2 shovels of soft wood sawdust in 12 seconds. Fire in a small amount of gasoline which leaked out onto the ground was easily extinguished in a few seconds with a small amount of sawdust.

Test No. 14.—Large tank containing 1½″ of mixture of No. 1 and No. 2 lacquer.

Time.	Remarks.
4:30:00	Fire started.
4:31:08	Sawdust applied.
4:32:01	Fire extinguished with 9½ shovels of soft wood sawdust in 53 seconds.

Test No. 15.—Large tank containing lacquer from Test No. 14 after sawdust had been removed as much as possible from the surface.

Time.	Remarks.
4:35:00	Fire started.
4:35:17	Sawdust applied.
	About 3 shovels of mixture of bicarbonate of soda and sawdust were applied, which nearly extinguished the fire. This exhausted the supply of bicarbonate of soda and sawdust, however, and the fire was finally extinguished in about 2 minutes with plain sawdust, although no special effort was made to get quick results.

Test No. 16.—Middle tank containing 2¾″ of gasoline.

Time.	Remarks.
4:40:00	Fire started.
4:40:50	Dry sand applied.
	Four shovels of sand were used, but as they had absolutely no effect, the fire was finally extinguished with 8 shovels of sawdust in about 56 seconds.

Remarks on above Tests. In the above tests an effort was made to have the lacquer thoroughly ignited and burning freely before any extinguishing medium was put upon it. Although the length of time elapsing between the ignition of the liquid and the application of the extinguisher varied considerably in different tests, the fires themselves when in the same tank and the same liquid had all approximately the same magnitude. The principal reason for the wide difference in time is that in some cases the lacquer in the tanks was cold and it required some time for it to become heated, but when the same tank and same lacquer was used for another test, the fire spread and progressed much more rapidly than in the first case.

In the cases where the lacquer was used for more than one test, the sawdust was skimmed off as quickly as possible after one test had been completed, and although some of it remained in the liquid, it did not have any important effect upon the results, judging from the extent and character of the fire.

The high velocity of the wind was undoubtedly a factor in making the fires more severe than they otherwise would have been, and it is very probable that all of them could have been extinguished more readily could the tests have been carried on indoors.

Conclusions. In view of these tests, the following conclusions appear warranted:—

1. Sawdust, if spread over the surface, will readily and successfully extinguish fires in inflammable liquids, particularly lacquer, when contained in moderate sized tanks such as those ordinarily used in manufacturing plants, or small fires in these liquids on the floor. The fires in gasolene in tanks up to the middle-sized one, which was used, were extinguished without difficulty, but there may be some question as to whether sawdust would have worked equally well on larger tanks.

The efficiency of the sawdust is undoubtedly due to its blanketing action in floating for a time upon the surface of the liquid and excluding the oxygen of the air. Its efficiency would be greater on viscous liquids than on thin liquids, since it would float more readily on the former than on the latter. The sawdust itself is not very easily ignited, and when it does become ignited it burns without flame. The burning embers are not sufficient to re-ignite the lacquer.

2. The character of the sawdust, whether from soft wood or hard wood, appears to be of little or no importance.

3. The amount of moisture contained in the sawdust is apparently not a factor. The dry sawdust which was used in some of the tests was prepared in order to represent the condition in which sawdust might be found after having been stored in a heated mill for some time. This material, however, was evidently as efficient as the untreated sawdust.

4. The depth of the lacquer in the small sized tank was of no importance. Although no tests were made with varying depths in the middle tanks, judging from the time that it took to extinguish comparative fires in the small and middle tanks, it is quite probable that the depth would not have been a factor in the middle tank. This assumption is reasonable, because the only way in which increased depth could be a handicap would be in allowing the sawdust to sink and expose a fresh surface of liquid before the fire had been extinguished at all points. Whether or not this occurred would depend upon the length of time necessary to extinguish the fire, since the sawdust requires an appreciable time before it starts to sink.

With the largest tank, on the other hand, it is quite possible that with greater depths than those tried, it might have been much more difficult to extinguish the fires. Tests at greater depths were not tried on account of the large quantity of lacquer required. This is not as important as might seem at first thought, because it appears from a number of inquiries which have been made that the average lacquer tanks in factories are about the same size as the smallest one employed in these tests, and that only rarely would anything larger than the middle-size tank be found.

5. Sand is not satisfactory for extinguishing fires in lacquer tanks because being heavy it sinks to the bottom and does not have the blanketing action possessed by sawdust. At the original factory tests, the sand worked fairly well for fires in lacquer upon the ground, but even in this case it did not extinguish the fire with any more readiness than sawdust, and it was heavier and more awkward to handle.

6. The sawdust can best be applied by means of a long handled, light but substantially built shovel with a blade of sufficient area to allow of taking up a considerable quantity of sawdust. The long handle is necessary to allow the operator to stand at some distance, since in some cases the fires were so hot that it was not possible to work at close range.

7. The admixture of sodium bicarbonate very much increases the efficiency of the sawdust, as shown both by the shortened time and decreased amount of material necessary to extinguish the fire. The effect of the carbon dioxide was clearly noticeable in the tests in that the flames occasionally made an effort to shoot sidewise and up from under the blanket of gas. It is probable that the bicarbonate mixture would have shown up to still greater advantage had it not been for the wind which must have blown the gas away. A further advantage of the addition of the bicarbonate is that it will greatly decrease the possible danger resulting from the presence of sawdust in mills. It would be very difficult, if not impossible, to ignite the mixture by a carelessly thrown match, or by any other ready source of ignition.

There is a possibility that some difficulty might arise from the caking of the bicarbonate, but if that should prove to be the case, it could be easily overcome by the addition of ten per cent of iron ore.

Galvanizing Plants.

By Charles Carroll Dominge (Member N. F. P. A.)

The name "Galvanized Iron" is given to iron which has been coated with zinc, to prevent it from rusting. The iron is simply dipped in zinc and is not coated by any galvanic process, as its name would imply. Zinc, after a short exposure to air, becomes coated with a film of oxide, which does not increase, and this preserves the zinc itself as well as the iron beneath it, from further decay, providing there is no galvanic action going on between the two metals. Probably, however, this action does take place, and the iron is in that case protected by its acting as an electro-negative element to the zinc. But whatever the true theory of the matter may be in practice, it is found that iron so coated resists the oxidizing effects of air and water extremely well.

Historical.

The French chemist, Dumas, states that as long ago as 1742, Malouin knew of a plan for coating iron with zinc. There is no doubt of the

fact, at all events, for it is stated in Bishop Watson's Chemical Essays, issued in 1786, that a method (essentially the same as that now in use for zincing iron) was then practiced at Rouen for coating hammered iron saucepans with zinc, and some of the operations are given. The first English patent for galvanizing iron was granted to Mr. H. W. Craufurd in 1837, and another for the zincing of iron which has been previously tinned was taken out by E. Morewood in 1841.

Use of Galvanized Ware.

Galvanized iron is largely consumed in the form of sheets, both plain and corrugated, for roofs, sheds, cisterns, water boilers and arches of fireproof floors; in the form of wire, besides that used in telegraph lines, a large quantity is employed for wire ropes, netting chains and the like, and it has innumerable minor applications, such as for water vessels, ship fittings and many other articles, formerly made of wood, copper, brass, slate, etc. For most of these purposes the zinc coating is much more lasting, and less troublesome than paint would be; but in certain situations, as where it is exposed to the action of sulphurous compounds in smoke, and where its surface is brought directly into contact with other deleterious chemical substances, its use cannot be recommended; and in these circumstances other plans should be resorted to for the protection of the iron.

There are two kinds of galvanizing, *i. e.*, hot and cold. The

Cold Process

is employed for a cheap grade of work, and is not as good as the hot process. The cold process is as follows: A pickling bath is made of a very weak solution of muriatic and sulphuric acid and water. From this pickle, the metal is washed in water "tumblers," then galvanized by immersing in a cold solution of sugar (or glucose), zinc and water, through which passes an electric current of from four to ten volts from copper contact to zinc plates. For galvanizing small wares an automatic rotary galvanizer is used which operates on the same principle as above described. The metal parts are placed in a slowly revolving drum (part wood and part insulated metal, the object of the non-conducting metal being to prevent the zinc from coating the drum) inside of a vat of the same solution. The drum has numerous perforations allowing the free mixture of the metal and the bath. The galvanized parts are automatically dropped or dumped into another revolving draining drum and then into a gas heated metal drying drum, which completes the process. The only heat used is at the drying drum.

The Hot Process

is the original process of galvanizing. The various operations are as follows: The iron is first placed in a "pickle" of hot sulphuric acid, this bath being necessary to thoroughly cleanse the metal. If cast iron

is used, it is first put through a hot hydrochloric acid bath and from there into a hot sulphuric acid bath, in order to take all sand off the casting, or to loosen the black scale, which is then scoured off by brushes dipped in sand and water.

The iron is then given a cold muriatic acid bath (called coating or aciding), and is then placed in a brick set, coke heated dry oven, and left there until the iron is thoroughly dry. The iron is then taken to the "galvanizing kettle," which contains spelter (zinc) the top of which is covered with finely powdered sal-ammoniac. The sal-ammoniac on top of the zinc bath prevents oxidation of the surface, and forms a sort of "flux," thereby preventing the iron (when placed in bath) from burning, and also helps as a coating acid. If no sal-ammoniac were used, it would take much longer to galvanize and the metal would probably be burned while passing through the bath.

The metal is then dipped into the zinc bath (either by tongs or cranes) and after the sal-ammoniac flux on top is moved to one side, the galvanized article is drawn out, thus completing the process. If small articles are galvanized, they are immediately placed in cold water, whereas large wares are merely drawn to one side and allowed to cool.

Galvanizing Kettles.

These are usually brick set kettles or bath, varying in size according to the articles to be galvanized, ordinarily about 5 feet wide, 12 feet long and 4½ feet high. The walls are 19 inches thick, the inner 7 inches being enclosed on the four sides by a boiler iron compartment containing the coke fire, the top is covered by metal plates. The coke fires are started by wood and are kept continuously going night and day for five and six years at a time, as it would take a long time to get the zinc in proper form for galvanizing if it once became chilled.

Drying Ovens.

These are usually enclosed in twelve-inch brick walls with steel beam and boiler iron top, while the base is composed of half-inch iron plates, underneath which are the various flues with a coke fire at each end of the oven. The doors to the oven on each end should be constructed of three-sixteenths inch boiler iron, reinforced with angle iron, and the flue for the escape of the acid fumes should be of brick, tile lined, and should extend above the roof line.

The Hazards of Galvanizing.

The inspectors should advise the company as to the construction and location of the furnaces, boilers and dry ovens, and also as to the fuel to be used, coke or coal being preferable to wood. The setting of each should be investigated thoroughly, and the floor around them, or certainly that portion within a radius of, say, 12 feet, should be non-combustible.

A good metal hood should be provided over the entire furnace. Coke refuse should be placed in metal (not wood) barrels, and self-closing oily waste cans should be installed.

Acids.

The acids, hydrochloric and sulphuric (oil of vitriol), which are received in iron drums and carboys, should be kept in a separate cut-off section, not exposed to the direct rays of the sun. An ideal location would be in a cool place on the shady side of the factory yard, as the firemen are very loath to enter buildings containing acids on account of their deadly fumes.

Construction of Buildings.

The usual construction is frame, of very "light" type, with earth base. In new buildings would recommend "reinforced concrete" or "mill construction."

Stables.

Inspectors should report whether there are open gas lights which should be protected by approved lanterns, as numerous fires have been caused by hay being tossed against same. If electricity is used the same should be approved by the underwriters having jurisdiction. Wiring should never be allowed to be hung on nails, or over piping or other metallic substances. If motor trucks or automobiles are housed the standards for gasolene, etc., will be found in "Live Articles on Special Hazards," under "Garages."

Fire Protection.

A goodly supply of fire buckets (chiefly filled with sand), a 4-inch standpipe riser with sufficient "labeled" hose and a good tank supply, an approved automatic alarm service, together with a watchman ringing hourly rounds, nights, Sundays and holidays, would make a "galvanizing plant" a fairly desirable risk from the underwriters' viewpoint.

Department of Fire Record.

Automobile and Bicycle Factories—Fire Record.

Although the number of fires in our record for this classification is smaller than in many records which have been given, there are many interesting facts brought out in regard to the fire hazards in this growing industry.

A study of the common causes does not show any marked difference from that of many other records. As usual, fires caused by rubbish and sweepings, also by boilers and fuel, comprise a good percentage of the common causes, namely twenty-three and six tenths per cent each in this record. An examination of the special hazard causes emphasizes the very important part that gasolene vapor plays. Gasolene vapor alone is charged with forty-six and five tenths per cent of the special hazard fires, or twenty-nine and five tenths per cent of all known causes; while indirectly gasolene vapor through engine testing is responsible for ten per cent of the special hazard fires, or six and three tenths per cent of all known causes. Eleven and six tenths per cent of special hazard fires, or seven and four tenths per cent of all known causes, are due to the various furnaces and ovens used for treating metal, enamelling, japanning, etc. As might be expected, the largest number of fires in this class, or sixty-three and two tenths per cent of known causes, originate from special hazards. A close examination of these fires shows that most of them are caused by carelessness and an absolute disregard of the necessary precautions for handling gasolene. Until employees can be made to realize that gasolene cannot be treated with impunity, it would appear as if fires starting from this cause will continue to form a large part of those reported in such factories.

One of the most encouraging facts brought out by this record is the very satisfactory showing of automatic sprinklers in extinguishing sixty-nine per cent of these fires and holding in check twenty-six per cent, while in only five per cent were the sprinklers classed as unsatisfactory. With respect to the size of loss, the showing is equally as good, in that forty-six per cent did

not claim any loss, and fifty-one per cent a small loss, leaving only three per cent of large loss fires.

Since so many of these fires are caused by carelessness of employees with gasoline, it is not surprising that sixty per cent of all fires were discovered by employees, and eighty-one per cent of those starting from special hazards; also that the day fires were in the majority, particularly those due to special hazards.

A further study of the sprinkler tables does not indicate any marked superiority of any one form of primary water supply. It is of interest to note that the gravity tank with its average pressure of thirty-seven pounds is charged with the largest number of heads opening in extinguished fires, namely, an average of five. It is noticeable, also, that the fires extinguished showed a slightly higher average water pressure than those held in check; while the number of heads opened is decidedly less in the extinguished fires as compared to those held in check. The average of six heads opening for all fires is somewhat more than in many records, but is readily explained by the fact that so many of these fires were unusually severe because of the gasolene present.

An examination of the table showing the room in which fire occurred clearly brings out the desirability of having the testing room cut off from the main buildings; also the danger of fires in the repair department and around oily platforms and yard. It is probable that many fires will continue to occur in the testing room, but the loss may be reduced to a minimum if this room is constructed with a full appreciation of this fact.

The conclusions drawn from the study of these fires indicate that sprinklers are very desirable in such properties and are the best available means to off-set the dangers which even a careful use of gasolene presents.

Automobile and Bicycle Factories—Fire Record

Total Number of Fires, 110.

1. CLASSIFICATION OF CAUSES.

Summary

Common Causes.

	No. of Fires.	Per Cent of Common Causes.	Per Cent of Known Causes.
Lighting	3	8.8	3.2
Heating	1	2.9	1.0
Power	2	5.9	2.1
Boiler and Fuel	8	23.6	8.4
Chimneys and Flues	2	5.9	2.1
Sparks	3	8.8	3.2
Smoking	2	5.9	2.1
Lightning	4	11.7	4.2
Matches	1	2.9	1.0
Rubbish and Sweepings	8	23.6	8.4
Total	34	100.	

Special Hazard Causes.

	No. of Fires.	Per Cent of Special Hazards.	Per Cent of Known Causes.
Brazing	4	6.7	4.2
Furnaces and Ovens	7	11.6	7.4
Buffing	3	5.0	3.2
Forge	3	5.0	3.2
Engine Testing	6	10.0	6.3
Gasolene Vapor	28	46.7	29.5
Miscellaneous	9	15.0	9.5
Total	60	100.	

Common Causes	34	35.8
Special Hazard Causes	60	63.2
Incendiary	1	1.0
Total Known Causes	95	100.
Unknown Causes	15	
Total	110	

Details.

Common Hazards.

Lighting 3
- Lighted candle left on shelf ignited woodwork..... 1
- Careless handling of a kerosene lantern or matches used in lighting same..... 1
- Defective electric wiring 1

Heating 1
- Combustible material too near heating apparatus..... 1

Power 2
- Gas escaping from engine ignited by hot exhaust..... 1
- Loose screw on relay allowed the armature to drop and ground on opposite side..... 1

Boiler and Fuel..... 8
- Spontaneous combustion in coal..... 1
- Overheated breeching from boilers..... 1
- Coal gas escaping from fire box of boiler ignited..... 1
- Boiler fire..... 1
- Sparks from boiler stack 2
- Back draft from boilers 1
- Ashes placed too close to frost box protecting tank riser..... 1

Chimneys and Flues..... 2
- Combustible material too near smoke flue..... 2

Sparks 3
- Sparks from locomotives.

Smoking..... 2
- Lighted pipe in pocket of employee's coat left hanging on nail. 1
- Lighted cigarette thrown in corner by employee..... 1

Lightning 4

Matches 1
- Employee stepped on match.

Rubbish and Sweepings..... 8
- Spontaneous Ignition 6
  - Oily rags..... 3
  - Rubbish left by sprinkler workman, in box..... 1
  - Keg of nails and sawdust into which sweeper had poured linseed oil..... 1
  - Not known..... 1
- Oily waste in contact with engine-testing exhaust pipe..... 1
- Fire in rubbish barrel outside from unknown cause..... 1

Special Hazards.

Brazing 4
- Pot of melted resin accidentally overturned on brazing furnace. 1
- Kettle of resin caught fire while being heated on the furnace... 1

Small fitting in air pipe to brazing furnace blew out, allowing gasolene to flow on floor, where it was ignited..... 1
Leak in pipe to gasolene braziers..... 1
Furnaces and Ovens 7
Supply pipe furnishing gasolene gas broke..... 1
Broken union to fuel pipe 1
Valve on burner broke, throwing burning oil into the room.... 1
Gas feed valve left open after pressure fan was stopped..... 1
Defective brickwork over core oven..... 1
Gas from enameling oven ignited..... 2
Buffing 3
Spontaneous combustion of dust and oil from buffing..... 3
Forge 3
Sparks from forge in blacksmith shop..... 2
Pot of grease being heated on coal forge ignited 1
Engine Testing 6
Back fire from carbureter..... 5
Sparks from exhaust flying into bin of excelsior..... 1
Gasolene Vapor.....28
Ignited from sparks..... 7
Employee washed floor with gasolene to remove varnish; then started to test magneto coils, which resulted in a flash fire that ignited a pan of gasolene and varnish 1
Two employees were emptying gasolene tank used in machine shop into sewer, when a spark from forge ignited it..... 1
Sparks from miscellaneous sources..... 5
Vapor ignited by match or other open flame..... 8
Watchman's lantern ignited vapor..... 1
Employee used gasolene to clean automobile parts before starting out with machine, and then lighted match to light lamps on machine..... 1
Match stepped on near open gasolene tank 1
Gasolene mixture thrown in closet trough, ignited by match carelessly thrown in later..... 1
Workman washing hands in gasolene used lantern for light 1
Employee was using gasolene near open furnace..... 1
Gasolene torch overturned, setting fire to oil and gasolene on floor..... 1
Tester lighted match outside test house door..... 1
Miscellaneous gasolene vapor fires 13
Employee was washing a machine with gasolene..... 1
Five-gallon can had just been brought in, and exploded from some unknown reason..... 1
Gasolene caught fire while men were repairing machine. 1
Gasolene ignited under car as it started..... 1

Gasoline vapor ignited—reason unknown..... 1
Gasoline ignited from overheated engine..... 1
Gasoline poured into sewer pipe..... 1
Hot iron dipped into sink where gasoline had been poured..... 1
Explosion in gasoline engine ignited gasoline in tank.... 1
Gasoline ignited while filling tank..... 2
Gasoline ignited from valve on piping of car where stem had been removed 1
Drop light broke, causing gasoline vapor present to become ignited..... 1

Miscellaneous..... 9

Employee in lighting gas jet ignited oil dripping from his fingers, and shook the fire from his hands into the dip trough, igniting residuum in it 1
Employee heating a small pan of oil with a hot iron ignited same 1
Escaping gas ignited from lantern..... 1
Charging defective storage battery..... 1
"Prestolite" gas tank leaked slightly and watchman's lantern ignited the gas..... 1
Explosion of hot metal..... 1
Burning old paint off body of automobile..... 1
Fast running lathe ignited shavings on floor below it..... 1
Gas-flame from blow-pipe ignited asphaltum paint on workman's bench 1

2. MISCELLANEOUS STATISTICS.

Analysis of Losses.

Fires Where Sprinklers Operated.

	Common Causes.		Special Causes.		Unknown Incendiary Exposure.		Total No. of Fires.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
No Claim	8	53	15	40	2	25	25	42
Small Loss	7	47	21	57	5	63	33	55
Large Loss	..	..	1	3	1	12	2	3
Total	15		37		8		60	

Relation Between Effect of Sprinklers and Losses.

	Extinguished.		Held in Check.		Unsatisfactory	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
No Claim	25	60	3	19	..	..
Small	17	40	12	75	2	67
Large	..	..	1	6	1	33
Total	42		16		3	

All Automobile and Bicycle Factory Fires.

	Common Causes.		Special Causes.		Unknown Incendiary Exposure.		Total.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
No Claim	13	40	18	30	2	12	33	30
Small Loss	15	45	38	62	7	44	60	55
Large Loss	5	15	5	8	7	44	17	15
Total	33		61		16		110	

Fires Where Sprinklers Were Not Affected.

	Common Causes. No. of Fires.	Special Causes. No. of Fires.	Unknown Incendiary Exposure. No. of Fires.	Total.
No Claim	2	2	..	4
Small Loss	3	9	1	13
Large Loss	..	..	..	..
Total	5	11	1	17

Protection Other Than Automatic Sprinklers.

In eight fires hose streams were used in connection with sprinklers in extinguishing fires, while in four instances sand was used effectively, and in six cases hand chemical extinguishers were used together with the sprinklers.

Protection Where Sprinklers Were Not Used.

Of the fires put out without the use of sprinklers, six were extinguished with hand chemicals, three with sand, and one each with hose from standpipe and water pails.

Amount of Water Used by Automatic Sprinklers.

In fifteen fires the amount of water used by the sprinklers was reported, the average being approximately 4,000 gallons, a somewhat larger amount than our records show for most classifications.

16,500 gallons ..... 1 fire.
13,000 " ..... 1 "
6,000 " ..... 1 "
4,800 " ..... 1 "
4,000 " ..... 2 fires.
3,000 " ..... 2 "
2,500 " ..... 1 fire.
700 " ..... 1 "
600 " ..... 1 "

500 gallons .....1 fire
200 " .....1 "
150 " .....1 "
60 " .....1 "

3. ROOM IN WHICH FIRE OCCURRED.

	Common Causes.		Special Causes.		Unknown Incendiary Exposure.		Total.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Boiler	8	30.7	..	..	1	7.1	9	9.7
Testing Room	1	3.8	11	20.7	1	7.1	13	14.0
Repair Shop	..	..	5	9.4	..	..	5	5.3
Stock Room	3	11.6	..	..	..	..	3	3.2
Roof	3	11.6	..	..	..	..	3	3.2
First Floor or above (no other data)	1	3.8	..	..	1	7.1	2	2 2
Basement	1	3.8	3	5.7	2	14.3	6	6.6
Yard or Platform	..	..	4	7.5	1	7.1	5	5.3
Storage	..	..	..	..	3	21.5	3	3.2
Shipping	..	..	2	3.8	..	..	2	2.2
Machine Shop	..	..	4	7.5	1	7.1	5	5.3
Brazing	..	..	3	5.7	..	..	3	3.2
Carpenter Shop	1	3.8	2	3.8	..	..	3	3.2
Paint or Varnish	2	7.7	1	1.9	..	..	3	3.2
Engine	..	..	2	3.8	..	..	2	2.2
Lavatory	..	..	2	3.8	..	..	2	2.2
Miscellaneous	6	23.2	14	26.4	4	28.7	24	25.8
Total with data	26		53		14		93	
No data given	7		8		2		17	
Totals	33		61		16		110	

4. DAY OR NIGHT FIRES. (Day Fires 6 a. m. to 6 p. m.)

	Common Causes.		Special Causes.		Unknown Incendiary Exposure.		Total.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Day	15	45	41	71	8	50	64	60
Night	18	55	17	29	8	50	43	40
Total with data given,	33		58		16		107	
No data	1		2		..		3	
Total	34		60		16		110	

5. PLANT IN OPERATION.

	Common Causes.		Special Hazards.		Unknown Incendiary Exposure.		Total No. of Fires.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Plant in operation .	13	55	48	81	7	47	68	66
Plant not in operation	16	45	11	19	8	53	35	34
Total with data given,	29		59		15		103	
No data	4		2		1		7	
Total . . .	33		61		16		110	

6. HOW DISCOVERED.

	Common Causes.		Special Hazards.		Unknown Incendiary Exposure.		Total No. of Fires.	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Employee . . .	10	31	47	81	6	40	63	60
Watchman . . .	17	53	7	12	3	20	27	26
Thermostat . . .	..	..	..	..	..	..	..	..
Sprinkler Alarm .	3	9	3	5	2	13	8	8
Outsider	2	7	1	2	4	27	7	6
Total with data given,	32		58		15		105	
No data	1		3		1		5	
Total . . .	33		61		16		110	

SPRINKLER FIRE RECORD.

7. EFFECT OF SPRINKLERS.

	No. of Fires.	Per Cent of Whole.
Extinguished or practically extinguished fire	42	69
Held fire in check	16	26
Unsatisfactory	3	5
Total	61	
No Claim	28	46
Small Loss	31	51
Large Loss	2	3
Total	61	

8. UNSATISFACTORY SPRINKLER FIRES.

S-6515. Building was a six-story, monolithic, reinforced concrete structure. Fire started on the fourth floor in a section devoted to upholstering automobile bodies. The large amount of inflammable material present made a quick, hot fire which spread rapidly in this unsprinklered portion through the large unprotected opening into division "C," where, having much combustible material on which to feed, it made rapid headway.

Division "C" was equipped with the old style, single source supply, lever type Grinnell automatic sprinklers. Although these sprinklers operated properly, the weak equipment was unable to cope with the volume of fire which would have spread further but for the effort of the fire department.

Summary: **Unprotected openings and unsprinklered portions.**

(*For details of above fire see April, 1908, Quarterly.*)

S-8085. Fire occurred in the dust house, a wooden structure located on the roof of the main building, in which the dust is received from the woodworking department. The cause of the fire was spontaneous combustion in dust saturated with oil. The building was equipped with automatic sprinklers, but the water supply to same was shut off because of cold weather. The fire was confined to dust house, and extinguished in about fifteen minutes by the use of two streams from yard hydrants.

Summary: **Sprinkler system shut off.**

S-12783. This fire started under a lumber rack in the carpenter shop of the automobile factory, and was probably caused by spontaneous combustion of oily rags used for finishing. The three sprinklers failed to extinguish the fire under rack.

Summary: **Obstruction to distribution.**

(*For details of above fire see October 1912 Quarterly.*)

9. POINTS OF INTEREST FROM FIRE REPORTS.

Hazards.

H-3393. This fire occurred in testing building, a small one-story frame structure, situated eleven feet from main building. The watchman stated that he had visited testing building at every round prior to the time of the fire. When making his round at 1 a. m. he discovered that the large swinging doors to the testing building were partly open. Since it was necessary to close same from outside, he registered portable clock, set his lantern on the floor, and went outside to close the doors. As he was about to re-enter the building, the flame of his lantern ignited what was presumed to be gasoline vapor, and in an instant the flame spread to the area where the gasoline pump was located. It was stated by the superintendent that no automobiles had been tested for three days and that the room had been thoroughly washed, but evidently gasoline was used for some purpose about the building a short time prior to fire. The watchman hurried to the fire alarm box across the street, pulled in the alarm and

returned to the fire, and in his endeavor to play a small stream from the hand hose onto the fire he was severely burned. The watchman's clock was thrown aside to enable him to work better, and was destroyed. The fire spread quickly to the main building, which was entirely enveloped in flame when the firemen arrived.

The fire department was open to criticism in that eleven streams were taken from a six-inch main fed by a four-inch main with only fifty-five pounds static pressure and the help of one steamer, also that the hose was so laid that eight lengths were destroyed. The barrel of the gasoline pump was fused, although the buried tanks were intact. The plant wac valued at $57,000, and was a total loss.

The danger of using an ordinary lantern in any part of a factory of this kind is well brought out.

H-6150. Automobile was being loaded on flat-bottom freight car. In draining tank a little gasoline was spilled. When it became dark a lantern was obtained, and although in the open air, there had not been sufficient motion to drive off gasoline fumes, which were ignited by lantern. Fire was extinguished by the use of sand and hand extinguishers. Loss, $400.

H-6185. Workman was washing a chassis of an automobile with gasoline; vapor came in contact with fire in open furnace, resulting in a severe explosion and total loss of large plant. Loss, $51,200.

H-8384. Fire started from spark blown from engine exhaust into excelsior. This portion of plant was unsprinklered. An excellent private fire department was organized among the employees, but as this was Saturday afternoon no one was on duty. Loss, $200,000.

S-8164. Fire was caused by the explosion of gas, liberated on account of incomplete combustion, at the burners in a metal dry oven used to dry armature coils and japanned motor parts. Explosion occurred when doors of oven were opened by employee and contents immediately caught fire.

S-10996. Automobile had just been backed out of the chassis testing room, preparatory to being used. The gasoline tank, located under the seat, had been filled by an employee, and he had just stepped off the running board when there was a flash, caused by the igniting of the gasolene fumes by the front lamps which were burning. Fire was extinguished by the use of hose stream from nearby hydrant, together with hand chemical extinguisher and sand; also one sprinkler opened over doorway.

S-13314. A pot in which aluminum was being melted burned through, allowing the contents to drop to the floor. The pot was heated with a system by which crude oil was delivered at burner under two or three pounds pressure by a pump. As this accident had occurred on previous occasions, no immediate steps were taken to shut off the burner and remove the aluminum. As the blaze increased and prevented the men from getting at the valve, which was about six inches from the furnace, a chemical extinguisher was used without success. Water was then thrown on by one of the employees, and an explosion followed. This heat opened four of the sprinklers. The oil supply being shut off at the pump the fire burned

itself out in about fifteen minutes. The explosion lifted the plank and timber roof several inches, which, in settling, went back into position. It also damaged the woodwork, and blew out all the glass, and twisted the metal frames in the two monitors. The expanded metal and plaster partition between the vault and the door opening into the blacksmith shop was blown outward, and would probably have been more seriously damaged had not the double doors been open.

S–11780. Two apprentice boys were emptying dirty gasolene from a wash tank into sewer in first floor of testing building. Tank was forty-gallon capacity, and was made of galvanized iron with portable metal cover. While pouring contents into sewer a spark from forge ignited gasolene in tank and in sewer. Prompt action of employees in thrusting the metal cover over the tank and shoveling sand into sewer, put out fire before it made much headway.

Automatic Sprinklers.

S-5916. Fire occurred inside of automobile top which rested on the floor. The room was crowded with automobiles, and in addition was used for the storage of automobile tops and parts, smithy and assembling of automobiles.

Sprinklers operated and held the fire in check, confining it to the automobile top in which it originated. Four chemical extinguishers, obtained from neighboring garage, sand and water pails and two-inch hand hose supplied by roof tanks, were also used in extinguishing the blaze.

This is a remarkable exhibition of automatic sprinkler protection, for although the fire was so hot as to open eighteen heads, an automobile standing about two feet distant from the fire was not damaged, the ceiling of the room only being blackened.

S-5949. This fire is interesting in the fact that the original fire was practically extinguished with hand chemical extinguishers, but the employee who was working on the automobile in which fire originated had about three gallons of gasolene in an open pail, which was kicked over in the excitement just as the original fire was under full control. The vapors from the gasolene were ignited and consequently a flash fire resulted which opened seven heads; these delivered a large volume of water which completely extinguished the fire before the city department arrived on the ground.

S-12948. Sprinklers are shut off in winter and were shut off at time of fire, but were later turned on, and they extinguished the fire. Previous to turning on of sprinklers, chemical extinguishers were used, but they did not prove sufficient to check the fire fed by gasolene gas.

S-11212. Considerable delay took place in shutting off water from sprinklers, as gate valve in yard shut off by turning to left instead of to right, and thus caused the firemen to become confused.

Inside Protection.

H-4102. Fire was caused by spark from unknown source igniting gasolene vapor under machine being repaired. It spread to another automobile fifteen feet away, but was put out by the use of fourteen chemical extinguishers before the fire department arrived.

H-7506. Watchman discovered small fire in roof over boilers while making rounds. Before fire department arrived, several employees in vicinity entered buildings, and by use of hose from three one and one half inch standpipes held fire in check until arrival of department.

H-8268. Oil escaping from furnace took fire. Foreman shut off main valve to furnace, and then with assistance of other employees held fire in check with nine hand chemical extinguishers until standpipe hose was brought into use, which extinguished it.

Alarm Service.

H-6497. Watchman's clock did not properly hold dial record, allowing three or four rounds to appear within space for one half hour, then suddenly jumping to correct location.

Clocks should be kept in perfect condition at all times.

S-8164. Fire was out before city department across the street arrived. Central station valve alarm operated successfully, but sprinklers were not in service long enough to actuate supervisory devices on tank.

Statistics: Central station valve alarm..... 10.40 a. m.
City box..... 10.41 a. m.
Valve closed..... 10.41 a. m.

10. NUMBER OF SPRINKLERS OPENED.

No. of Sprinklers Operating.	Extinguished Fire. No. of Fires.	Per Cent.	Held Fire in Check. No. of Fires.	Per Cent.	Unsatisfactory. No. of Fires.	Total. No. of Fires.	Per Cent.	No. of Sprinklers Operating.	No. of Fires.	Per Cent of Whole.
1	17	43	4	25	..	21	37	1	21	37
2	7	17	5	32	..	12	21	2 or less	33	58
3	3	8	0	0	1	4	7	3 or less	37	65
4	3	8	1	6	..	4	7	4 or less	41	72
5	1	2	1	6	..	2	4	5 or less	43	75
6 to 9 inc.	5	12	1	6	..	6	10	Less than 10	49	86
10 to 24 inc.	4	10	2	13	..	6	10	Less than 25	55	96
25 to 49 inc.	0	0	1	6	..	1	2	Less than 50	56	98
50 and over	0	0	1	6	..	1	2	50 and over	1	2
Total....	40		16		1	57				

Average number of sprinklers opened, not including unsatisfactory, 6.09.

11. EFFICIENCY OF WATER SUPPLIES TO SPRINKLER SYSTEMS.

Primary Water Supply.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Per Cent. of Fires.			Average Pounds Pressure.			Average Number Sprinklers Opened	
					Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check
Waterworks,	26	45.6	60	6.9	31.6	12.2	1.8	60	63	43	3.2	19.4
Gravity tank,	13	22.8	34	5.0	12.2	10.5	..	37	33	..	5.0	5.0
Pressure tank,	12	21.1	93	4.2	17.5	3.6	..	94	88	..	4.1	4.5
Automatic pump,	6	10.5	78	8.0	8.8	1.8	..	79	75	..	3.6	30.0
Total,	57	100.0	63	6.0	70.1	28.1	1.8	66	55	43	3.8	12.8

12. EFFICIENCY OF WATER PRESSURES ON SPRINKLER SYSTEMS.

Pressure on Sprinklers.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Per Cent. of Fires.			Average Pounds Pressure.			Average Number Sprinklers Opened	
					Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check
Less than 15 lbs.,	1	1.7	8	1.0	..	1.8	..	..	8	..	..	1.0
15 to 24 inclusive,	2	3.5	15	2.5	3.6	..	..	15	..	..	2.5	..
25 to 49 inclusive,	20	35.1	35	4.4	21.0	12.2	1.8	33	37	43	4.2	7.0
50 and over,	34	59.7	84	7.2	45.5	14.1	..	88	77	..	3.7	18.5
Total,	57	100.0	63	6.0	70.1	28.1	1.8	66	55	43	3.8	12.8

13. EFFICIENCY OF WET OR DRY SPRINKLER SYSTEMS.

Wet or Dry System.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Per Cent. of Fires.			Average Pounds Pressure.			Average Number Sprinklers Opened	
					Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check
Wet system,	48	84.0	62	6.2	57.9	24.5	1.8	66	53	43	3.5	14.0
Dry system,	9	16.0	72	5.1	12.2	3.6	..	72	70	..	5.3	4.5
Total,	57	100.0	63	6.0	70.1	28.1	1.8	66	55	43	3.8	12.8

14. EFFICIENCY OF WATER SUPPLIES TO SPRINKLER SYSTEMS —As Regards Amount of Loss.

Primary Water Supply.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Per Cent. of Fires.			Average pounds Pressure.			Average Number Sprinklers Opened.		
					No claim	Small loss	Large loss	No claim	Small loss	Large loss	No claim	Small loss	Large loss
Waterworks,	26	45.6	60	6.9	10.5	33.3	1.8	50	64	50	3.8	3.2	99.0
Gravity tank,	13	22.8	34	5.0	10.5	12.2	..	37	33	..	5.0	4.8	..
Pressure tank,	12	21.1	93	4.2	12.2	8.9	..	90	97	..	4.0	5.4	..
Automatic pump,	6	10.5	78	8.0	8.8	1.8	..	79	75	..	3.6	30.0	..
Total,	57	100.0	63	6.0	42.0	56.2	1.8	64	63	50	4.3	4.4	99.0

15. EFFICIENCY OF WATER PRESSURES ON SPRINKLER SYSTEMS —As Regards Amount of Loss.

Pressure on Sprinklers.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Per Cent. of Fires.			Average pounds Pressure.			Average Number Sprinklers Opened.		
					No claim	Small loss	Large loss	No claim	Small loss	Large loss	No claim	Small loss	Large loss
Less than 15 lbs.,	1	1.7	8	1.0	..	1.8	..	..	8	..	..	1.0	..
15 to 24 inclusive,	2	3.5	15	2.5	..	3.6	..	..	15	..	..	2.5	..
25 to 49 inclusive,	20	35.1	35	4.4	17.5	17.5	..	36	37	..	6.4	3.2	..
50 and over,	34	59.7	84	7.2	24.5	33.3	1.8	85	84	50	2.5	5.8	99.0
Total,	57	100.0	63	6.0	42.0	56.2	1.8	64	63	50	4.3	4.4	99.0

16. EFFICIENCY OF WET OR DRY SPRINKLER SYSTEMS. —As Regards Amount of Loss.

Wet or Dry System.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Per Cent. of Fires.			Average pounds Pressure.			Average Number Sprinklers Opened.		
					No claim	Small loss	Large loss	No claim	Small loss	Large loss	No claim	Small loss	Large loss
Wet system,	48	84.0	62	6.2	29.8	52.6	1.8	61	62	50	3.3	4.3	99.0
Dry system,	9	16.0	72	5.1	12.2	3.6	..	72	70	..	5.3	4.5	..
Total,	57	100.0	63	6.0	42.0	56.2	1.8	64	63	50	4.3	4.4	99.0

Note.—" Average number of sprinklers opened " does not in any case include the Unsatisfactory fires.

GENERAL FIRE RECORD.

Unsatisfactory or Serious Fires in Buildings Equipped with Sprinklers.

Where sprinklers fail the cause is, almost invariably, clear. These fires are selected to indicate such causes, that they may be generally understood and satisfactorily met.

S-14679. Fire took place in the engine room, a one-story wooden addition, nineteen by thirty-five feet, with hollow wood walls and a blind, unsprinklered attic. The sprinkler system was old standard, one supply, dry system, with modern Grinnell glass disc sprinklers. There were six heads in first floor spaced ten feet two inches by ten feet two inches.

The fire started in a coat one of the men had hung on a nail, and quickly burned through the wall and ascended to the blind attic through the hollow space in the wall. The six sprinklers opened and the dry valve tripped promptly; but the water could not reach the fire which spread rapidly and entered the second floor of main building and opened one sprinkler there. Fire was extinguished by public fire department with three hose streams. Loss, $414.72.

Summary: **Unsprinklered portions.**

S-14675. Fire started from unknown cause in **unsprinklered** shed adjoining dry kiln of carriage and automobile body factory. About seventy-five Hibbard and Neracher heads, supplied by twenty-inch main under pressure of forty-five pounds, opened and held fire in check in main building. A 7000-gallon gravity tank was also a factor in supplying the sprinklers. Loss, $30,000.

Summary: **Unsprinklered portions.**

S-14762. Fire occurred in one-story brick shaving house of woodworking plant. About sixty sprinklers were located in room on dry system. On account of the danger of heads being opened by pieces of heavier refuse in the shavings, the valve controlling sprinklers in this building is kept permanently closed. Fire was discovered by watchman, who sounded alarm on A. D. T. system, and is said to have opened valve controlling sprinklers in this building. Public fire department used nine hose streams, and private brigade one stream, all from hydrants supplied by city waterworks, which proved adequate both as to pressure and volume. Loss, $2,825.

Conclusion: Suitable guards or other means should be found to protect heads so that sprinkler systems may have water turned on at all times.

Summary: **Water shut off.**

S-14819. Fire started by overheating of newly rebabbitted bearing on swing-saw in first story of brick building, plank and timber floors, used by a moulding and picture frame manufacturer. Fire communicated to second story through belt opening and followed oily belt. In second story belt ran close to stacks of moulding which quickly ignited and made an extremely hot fire. Fire was held in check by sprinklers until arrival of fire department. Loss of $16,997 was largely due to water damage of stock.

Summary: **Especially inflammable contents and stock susceptible to smoke and water damage.**

S-14873. A spark from boiler fire flew back and ignited pile of material which had been placed in boiler house to be burned. Sprinklers had been disconnected because of extensive changes being made in buildings. Alarm was promptly given and fire was extinguished by excellent use of six hose streams on part of employees. Loss, $392.50.

Summary: **Sprinklers disconnected.**

S-14846. Electrician was cleaning with gasolene, electric motor located on the floor of boiler house, and was using a lantern, as light was poor. The fire spread to plank roof, fed by two small wooden boxes, destroyed the monitor along the entire length of this roof and badly charred the main roof planking. The steel trusses quickly warped, allowing the roof to sag until supported by the upright boilers, and pulling the upper part of the brick walls together so that they will need to be rebuilt for a few feet at top.

The height of roof, which was between forty and forty-five feet above the ground, together with some delay in giving alarm, were factors in favor of the fire. Loss, $12,000.

Steps should be taken to prevent the use of gasolene by employees not familiar with its dangers.

S-14677. Fire from unknown cause started between the studding in the walls at the second floor of a metal-clad wooden building used for painting, storage and finishing by a coffin manufacturer. This building was made of two by six-inch studding, sheeted on the two sides with corrugated iron and wood. This building, known as No. 2, was joined to a two-story building, No. 3. The heat from the fire passed up to the roof of No. 2 and to the ceiling of the second floor of No. 3. Fire spread along the roof and ceiling, opening a total of fifty-seven heads, some of which were seventy feet from the fire, although four heads in building No. 3 and nine in building No. 9 confined the fire to a small space and practically extinguished it. The loss was $17,731 because of damage in the walls out of reach of sprinklers, and large amount of water.

Summary: **Obstruction to distribution.**

S-14862. The fire which severely exposed this plant occurred in the afternoon in the two and one-half-story frame rag shop located on the south side of plant. The exposure was forty-three feet distant from "A," a one-story building, and ten feet from "E," a three-story building. Exposure

was approximately 175 by 65 feet in area, of ordinary frame construction, two and one half stories high and partly slate covered. All vertical openings were said to be unprotected. It was occupied as a rag and junk storehouse and was well filled with baled and bagged rags, paper, etc., at the time of fire.

Buildings "A" and "E" had brick walls, plank and timber floors, and protected by window shutters or wired glass. The sprinkler protection consisted of Manufacturers' heads with 1-2-3 pipe sizes and spaced ten by twelve feet apart in eight foot bays, and nine by ten feet in nine-foot bays. The only water supply consisted of two mains, six and eight-inch connections from twelve and twenty-four inch mains; pressure, fifty-five pounds. By the time fire department arrived frame building was enveloped in flame. In all, fifteen hose lines were used, while one steamer was stationed at connection to sprinklers in case of emergency.

Fire lasted several hours, and the heat must have been very severe. The brickwork and stone window sills were badly spalled and the wood core of fire shutters in some cases burned out. All shutters are said to have been closed on building "E," but from indications after the fire, one or two may have been open. Only one sprinkler head opened in building "A." This was a 365 degree head located in monitor where they were all high test heads. The standpipe hose streams used in this building on ceiling and underside of roof undoubtedly wet the sprinklers and prevented their opening, for they were severely exposed. In building "E" twenty-eight out of forty-two heads opened on third floor; sixteen out of thirty-four on second floor; and two out of thirty-four on first floor.

Effect of Fire. The rag warehouse was burned to the ground. Practically all the windows and frames in south wall of building "A" were burned out. Windows in monitor on roof were also burned out or glass badly cracked and frames charred. The wired glass windows in the second and third floors of building "B" above roof of building "A," 105 feet from exposure, were badly cracked by the heat. Building "E" was exposed the most severely, being only ten feet away. The bricks in wall and stone sills were badly spalled. The roof at end was charred and burned through in several places, but this did not extend in for more than a foot or so.

Six shutters on end of third floor were either entirely burned off or had to be removed after fire to extinguish the wooden cores which were glowing embers. All sash and frames with one exception were burned completely out. The tinning on the remaining shutters is badly bulged and damaged, and on the second floor four shutters are missing. The shutters on the first floor were evidently not subjected to such severe heat, due to the fact that the rags in bags were stored in this section of exposing building. Only one window on this floor was completely burned out.

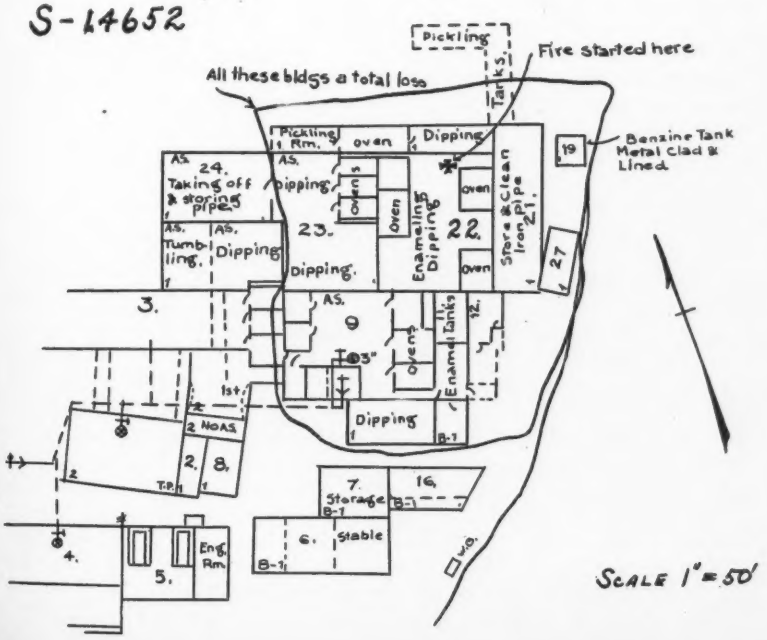
The ceilings are charred more or less in some cases near windows. This is especially noticeable above windows in second and third story on exposed side where planking is deeply charred even above sprinkler heads. This may have occurred after water was shut off sprinkler system, or shutters may not have been closed on these windows. The latter is probably

the case on the second floor, as there is a dark spot on wall where left shutter would be if open, and brickwork is not spalled at this point. The plant was showered with burning sparks and embers, but good tar and gravel prevented ignition of roof. Many fires were started in adjacent properties, mostly due to sparks on shingle roofs, in some cases as much as 3000 feet away.

Conclusions. This was a most severe exposure fire, but owing to the good shutter protection to building "E," in conjunction with the automatic sprinklers and standpipe streams, the damage was only moderate. This fire demonstrates the value of shutters and also contrasts very clearly the relative hazards of shingle roofs with tar and gravel roofs.

S-14652. This fire occurred in a woodworking and enamelling factory consisting of one to three-story open finish wooden buildings of a light rambling character, all joined together and with no cut-offs to separate the values or hazards. Buildings were erected from time to time as the business increased. The management of the plant was as good as could be expected in this kind of a factory.

Plant closed at noon Saturday and the fire started about 2 p. m. Watchman had passed through the building where fire started half an hour before. The fire started from unknown cause in the unsprinklered portion of the plant at the easterly end of the yard and destroyed buildings No. 9, 11, 12, 19, 21, 22, 23 and 27.



Only sixty per cent of the property was equipped with sprinklers and about seventy-five per cent of the manufacturing buildings. Sprinklers were Grinnell glass button, ninety-five per cent; International, Type "B," five per cent. Primary supply was city water through six-inch connection from a six-inch main which was fed from twelve-inch main 350 feet distant; pressure, seventy pounds. Secondary supply was a gravity tank of 4,300 gallons capacity, with bottom only two feet above highest sprinklers. Sprinkler piping was the 1–3–6 schedule, and in many places even poorer than this. Sprinkler system, like the buildings, was erected from time to time, and in many cases the sprinkler standards were entirely ignored.

Of the buildings destroyed by the fire Nos. 9 and 23 were the only ones that were equipped with automatic sprinklers, and in these sections the sprinkler system was weak and pipe sizes considerably overloaded. There is no question but that every one of the sprinklers in this section opened from the intense heat; in fact, many of them were melted up. Buildings No. 9 and 23 contained approximately ninety sprinklers. Buildings No. 3 and 24 were both equipped with sprinklers, and three to four heads on each line on each floor in these buildings at east end against the buildings destroyed were all opened, but apparently were of slight value in stopping the spread of the fire. The steamers probably took most of the water from the city mains.

Fire was discovered in the unsprinklered enamelling iron pipe room (building 22), by one of the employees, who was in the lot quite a distance north of the plant. He at once pulled public fire alarm box. About the same time a policeman half a mile from the plant, who saw the fire, also pulled in a public alarm. As this was Saturday afternoon, there were very few men near when the fire was discovered. These men attached the private hose to one of the hydrants and were about to use it when the city fire department arrived. Altogether four city alarms were turned in, bringing out considerable apparatus, a total of fourteen public hose streams being used in fighting the fire.

The buildings destroyed contained the most hazardous occupancy, for in them was done the boiling, mixing and cooling of enamel and varnish, also the dipping and baking ovens were located here. The room where fire was discovered had an area of about 6,500 square feet. It was not sprinklered. This room was used for the dipping of iron pipe in black enamel which was thinned with naphtha, so that there was plenty of inflammable material, which, with the light frame construction, gave the fire great headway before it was seen and before hose streams could be applied. Loss, $92,000.

Conclusions: The large loss may be attributed to the fire starting in unsprinklered buildings, also to poor and incomplete sprinkler system with light frame construction and no cut-offs. The hazard was especially severe, the inflammable contents being neither cut off nor separated from main part of the building. The hydrant protection was poor also, both from lack of an ample number of hydrants available and insufficient water for the same, thereby preventing the fire department from checking the fire sooner.

Summary: **Unsprinklered buildings should be cut off from sprinklered portions, and all sprinkler equipment should be brought up to the latest standards.**

S-14643. Fire occurred on Saturday afternoon in third floor of main mill occupied by a manufacturer of ladies' cotton hosiery. Building was four stories and basement, brick walls, plank and timber floors, with stairs and elevators cut off. Protection consisted of sixty-nine W. Kane No. 3 bulb root sprinklers in the room in which fire took place. These were installed in 1888, and had a fusing point of 165 degrees. Old standard pipe sizes were used, and sprinklers were spaced nine feet apart down eight-foot nine-inch bays. A static pressure of seventeen pounds was maintained on the heads from a 5,000-gallon gravity tank.

There was no watchman on duty at this time. On the day of the fire all the machinery had been cleaned and wiped off with rags which were placed in an open can in the middle of the room and also in a wooden box. The engineer, as nearly as could be learned, was the last person in the plant and left the same about one o'clock. About 3 p. m. the residents living on the opposite side of the street from mill heard the sprinkler alarm bell outside of the engine room ringing. They paid no attention to this and bell rang for what was said to have been fifteen to twenty minutes, when a boy coming down the street heard it ringing and noticed smoke coming from the windows on the third floor. He immediately notified a nearby engine company which responded promptly. The fire was extinguished by the city department using one hose stream from a steamer.

The fire apparently originated in or around the waste can and box near center of room, for opposite door to stair tower at this point the wooden columns were quite heavily charred, also the ceiling in one bay for a distance of ten feet directly over the waste can and box, which indicates that the fire was hottest at this point. It would also seem as if some of this charring must have taken place after sprinkler tank became empty.

The general indications are that the heat spread down the bays of the ceiling, and opened various sprinklers in each of twelve different bays (room contained seventeen bays). There is every appearance that something was wrong with the sprinklers. At points where some sprinklers have been replaced the ceiling shows no appearance of having been washed with water from the sprinkler, and at two points the ceiling is somewhat charred around the sprinklers. It is very evident that a number of these sprinklers (probably at least six) did not open. From men who were on the grounds, the day after the fire, it was learned that several sprinklers were found with links partially fused but not open. A number of these bulb root sprinklers also contained mud and sediment, and several of these (which were placed pendant) were so badly filled with sediment that no water had escaped through them. Just how many sprinklers were in this condition cannot be determined accurately, as some of this sediment was shaken out when sprinklers were removed from piping to put on new heads. There is said to have been four and probably more sprinklers in this condition.

The pressure from the gravity tank was light on this floor, about seventeen pounds, and this pressure was not sufficient to blow the sediment out of sprinklers in cases noted above, even after solder had fused and links and levers fallen apart. It is probable in the case of those sprinklers on which the links had started and then soldered together again that the heat was not sufficient to entirely fuse solder, and as the sprinklers had been in place for twenty-five years, there was no elasticity left to help throw off these links.

It is evident that the sprinklers held this fire fairly well in check for a while. The fire had begun to gain on the sprinklers, and if it had not been discovered just at this time it probably would have burned out the two upper floors of mill, as the sprinkler tank was nearly empty.

Conclusions: These old types of sprinklers should not be expected to give proper protection, and the same should have been replaced several years ago by modern approved heads.

Summary: **Sub-standard sprinkler equipment.**

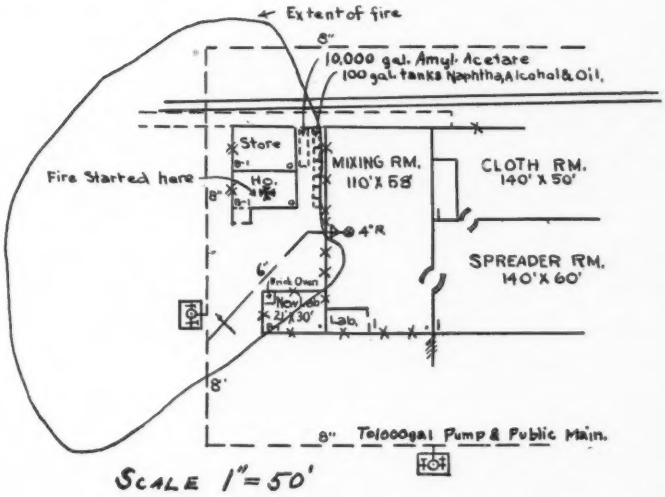
Celluloid Fire.

Special Report made up from Report of Underwriters' Bureau of New England (Member N. F. P. A.)

S-14839. This plant manufactures artificial leather by coating cotton cloth with a solution of celluloid. Plant consists of a main brick building of mill construction, 110 by 250 feet long, divided into four good fire sections. The finishing room section is located at north end, 110 by 52 feet, and exposed at north by a rubber factory seventy-five feet distant. The mixing room section is located at south end, 110 by 50 feet. The central portion of the building is divided laterally into two sections, the spreader room, 60 by 140 feet, and the cloth room, 50 by 140 feet. Each section is sprinklered on a separate connection. Double fire doors at all door openings. A one-story and basement chemical laboratory ell is located at the south end of mixing room, at the east side, projecting thirty feet, and twenty-one feet wide, the east side of laboratory being a continuation of the east side of mixing room. The laboratory is sprinklered, containing six heads. The basement is vacant and unsprinklered. Several of the windows in south end mixing room are wired glass in metal frames. The windows in laboratory ell and two windows in south wall adjacent to this ell were plain glass in wood sashes.

The one-story and basement storehouse where fire occurred was located fifteen feet south of mixing room and forty-five feet west of laboratory ell, and was an unsprinklered brick and concrete building, thirty-five by forty-five feet. The basement was constructed of heavy concrete walls with a concrete partition through the middle, forming two vaults, one about twenty

S-14839

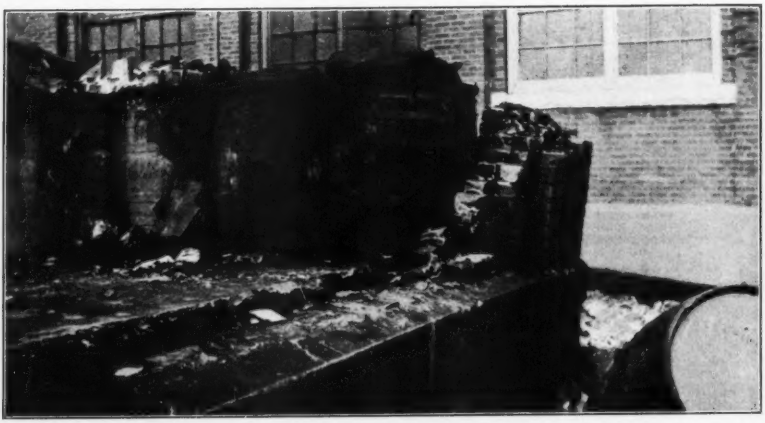


by thirty-five feet for storage of scrap celluloid, and one about twenty-five by thirty-five feet for storage of oils. The first floor or ceiling to vaults was an eight-inch reinforced concrete slab, reinforced with a heavy wire netting and heavy steel rods tied into the concrete walls as shown in one of the photographs. The first story walls were of brick, resting partly on the concrete vault walls and partly on the floor slab. At one end of the vault there was a brick ventilating chimney having an internal area equal to five per cent of the area of vault. Chimney had a peaked covering consisting of very light sheet lead which was intact, so far as is known, when fire started. There were no windows in north wall of storehouse and only a few windows elsewhere. Second floor was not divided by a wall and was used for storage of "dope." Roof consisted of corrugated iron, supported through the center by a steel girder. There was a padlocked fire door at door opening, located at east side of ventilating chimney.

Plant shut down Friday night and had not resumed operation on day of fire. So far as is known, the vault for storage of scrap celluloid was not entered since that time nor probably during that day. The second floor of storehouse was entered on Sunday. The last scrap celluloid put into storage vault was received about a month previous to time of fire and there was said to have been at least sixteen tons of scrap in boxes and barrels on hand at time fire occurred. This consisted mostly of comb and novelty scrap, but there was also some moving picture film scrap. The adjacent

vault contained oils, etc., used in the process of manufacture. The first story contained 125 barrels of prepared "dope" and a form of collodion consisting of nitrate of cellulose dissolved in acetone, which is one of the raw materials.

Early Tuesday afternoon, while two employees were working in mixing room and manager was in office of adjoining factory, the contents of celluloid scrap vault in storehouse burst into flames. There was no detonation or sound of violent explosion, but the manager noted a sound like a vigorous puff and saw flames shooting into the air. He immediately pulled the fire alarm box and went to south end of factory to see if fire doors were properly closed. The employees in mixing room had attended to this before he arrived. Private fire brigade from factory adjoining brought five or six hose streams into play. The public fire department arrived but found their services not needed. As near as can be ascertained the intense celluloid fire



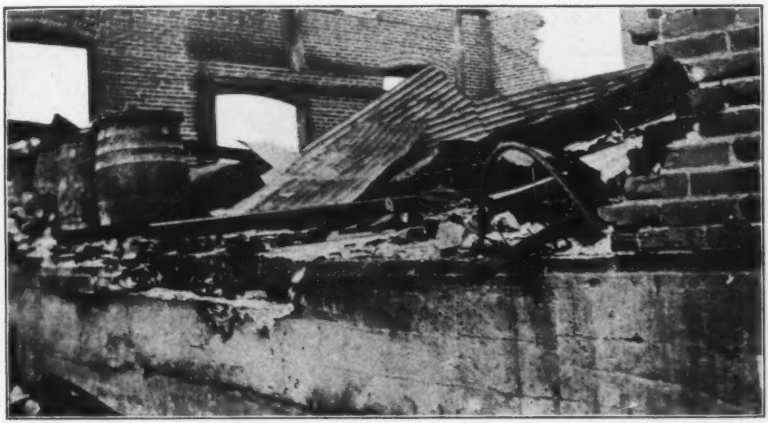
S-14839.

Figure 1. View showing how the floor slab has raised up and expanded so much that it cannot go back into its original position, and also how the slab, in lifting, tipped over the walk. The reinforcing rods all laid bare may also be seen.

was all over in from five to seven minutes. The private brigade did very creditable work. A can of "dope" was discovered on fire in mixing room (main building) and was extinguished by a chemical extinguisher. No sprinklers opened here, but all six heads in laboratory opened. The damage inside was very slight, however.

Wired glass windows covering two-thirds of south end of main factory were intact, though cracked. The ordinary windows were burned and broken out by hose streams. Hydrant house, fifty feet from storehouse, was charred on all sides. Grass and trees were scorched 150 to 200 feet away. Granite window ledges on laboratory were badly spalled.

The effect of the fire upon the storehouse is very interesting and may be appreciated by referring to the photographs. The heavy floor slab has been pushed upward out of the recess in which it was located, and moved so that it now rests upon the upper edge of vault wall about the recess. The slab seems to have expanded in area so that it could not settle back into the recess. The slab is deflected slightly upward and the reinforcement is bare in many places on the under side. The rod which extended around the edge of slab in the recess over which the principal reinforcing rods of the slab were hooked, is greatly expanded and has assumed various positions through twisting and bending. The brick walls were simply pushed over. There is no scattering of bricks whatsoever. Evidence seems to show that the hottest part of fire was at southeast end of vault and the wall at the east side was pushed over more vigorously than that on the north. The concrete wall of vault at east side is cracked by outward pressure, evidently by



S-14839.

Figure 2. This view shows the other side of the building where the wreckage was more severe. Note how the steel has expanded and ruptured the concrete.

the slab as it expanded and pushed its way upward. The arch over opening from vault into chimney is badly disintegrated with all reinforcement laid bare, which shows that the heat was most intense at this point where the flames were drawn up the chimney.

The damage to the fireproofing and walls is the greatest in this location, except the chimney is intact though the bricks are badly spalled. As air was accessible to this portion of the vault, the excessive damage over that of the inner portions is to be expected.

It is even not absolutely certain whether the failure of this concrete vault was due to a tremendously hot fire or to a mild explosion. It is entirely possible to account for every condition in the wrecked storehouse as

due to the failure and expansion of the reinforced concrete slab by heat, and the evidence points to this conclusion. We know that the heat developed in a fire which consumed perhaps sixteen tons of celluloid in a comparatively few minutes must have been enormous. The appearance of the disintegrated concrete, warped steel reinforcements and scorched vegetation at a great distance, as well as the spalled granite window ledges on the laboratory ell, also demonstrate this fact. From the best information obtainable there does not appear to have been any heavy detonation.

Conclusions. Whether or not an explosion occurred, fire or combustion of some nature must have first originated from a cause which may never be determined. Examples are numerous to show the tremendous heat involved in, and the rapidity of, burning celluloid. It would seem as

S-14839.

Figure 3. The windows burned out were not wired glass, while those remaining were wired glass.

if the normal inherent combustion of pyroxylin products may be expected to be of so violent and rapid a nature as to make the line of demarcation between a true explosion and combustion of explosive rapidity of little or no importance.

This storehouse was built in 1911 and was carefully designed for the purpose by prominent mill engineers. To reduce the cost, the original design was changed materially. As finally built, the vault was located below grade and the reinforcement and thickness of insulation reduced. Some of the steel was found to be within one-half inch of the bottom of the slab and the rods were insufficiently anchored to the walls to form a single monolith of walls and ceiling, so the slab in expanding caused a failure at this point. The reinforced arch over the opening to the chimney failed entirely, all steel being left bare. This point naturally received the most

intense heat. The basement walls were evidently not reinforced or, if so, had no rods extending into the slab. These walls were partly ruptured by the expansion of the slab.

It was evidently a mistake to build the floor slab with a joint between it and the walls. The whole should have been poured together to form a single monolith. An inspection of the vault could not determine this defect nor the insufficient insulation and reinforcement.

Lessons. In planning protection against the celluloid hazard, the great intensity of the fire over that of ordinary fires must be considered. Fireproofing must be much more than that used for ordinary occupancy. If sprinklered, the equipment should be planned on the assumption that much of the water will be evaporated by the excessive heat. If this concrete had

S-14839.

Figure 4. View of other side of building, showing the ventilating flue still intact.

been protected by firebrick or other adequate insulation, the loss possibly would have been slight, as the chimney evidently carried off heat without rupture.

As the explosive theory is tenable it would be well to care for the collection of gases formed by the combustion of celluloid without flame, by keeping the floor well above grade and providing liberal drains or vents near the floor, in addition to a chimney, to enable the heavy gases to drain out of the building.

Burning celluloid, whether in a fireproof vault or not, radiates heat for a great distance and its storage should be well isolated. This distance should be at least fifty feet.

Celluloid should be stored in as small quantities as possible. When large quantities are needed it should be divided into small amounts and stored in separate fire sections or preferably separate buildings. It is desirable to keep the amount subject to one fire down to five tons or less.

Fires in Which There Was Loss of Life.

These fires are intended to point out conditions under which loss of life occurs, that they may be known and guarded against.

Holocausts which are adequately reported in the daily press or are the subject of special investigation are not given herein; nor is any complete record of loss of life in fires at present obtainable.

S-14638. Fire occurred in a twelve-story and basement fireproof building and started on twelfth floor in space occupied by a company manufacturing a patented device to be attached to the carburetors of automobiles. A mechanic was at work under an automobile which had been brought into the building about three-quarters of an hour previous, and was supposed to have been fitting the device to the car. It is not known just what happened, but apparently for some reason the mechanic emptied the gasoline tank (about fifteen gallons) and then in some way the electric light became broken. There was a quick fire in which the mechanic was so badly burned that he died shortly afterward in the hospital. The fire itself was practically extinguished by the very efficient system of automatic sprinklers, with only a nominal loss.

It is evident from the above fire that sprinklers will hold fire in check where gasoline is present, but will not have much effect on the burning gasoline and that this burning gasoline will open a large number of sprinklers before the same is consumed.

H-9019. This fire started on the third floor of a six-story, ordinary brick building, the third floor being occupied by a button works manufacturing cloth, metal and celluloid buttons. Fire started just before 8 a.m. as employees were assembling in the building preparatory to going to work. The point of origin was on the third floor, two-thirds of the way back and near the stairway from the third to fourth floors. A wooden barrel containing celluloid clippings had been brought down these stairs the night before. The first indication of the fire was a rapid combustion or explosion of the contents of this barrel, probably igniting by a match or cigarette thrown there by one of the early-arriving employees. The fire quickly enveloped the third floor and spread to the fourth by the inside stairway and the exterior windows, thence by outside windows and the main stairway to the fifth and sixth floors. The rapid combustion was due in large part to the quantity of volatile combustibles used on the fourth floor for lacquering and enameling buttons.

The fire was under control in about one hour and extinguished in three hours by the fire department, being fought with high pressure streams from the street and from standpipes of building adjoining.

Three lives were lost, due to burns sustained by the fire. A girl employee was in the ladies' dressing room near where fire started. She came out and stood stupefied at the sight until her clothing caught fire and she received fatal burns. The treasurer of the company was fatally burned in an effort to put out the fire and rescue this girl. Another man employee was also fatally burned. Employees on the upper floors had a narrow escape. The fire escape on the front of this building runs in front of thin glass in wood sash windows all the way down, and the fire had cut off this fire escape and the stair shaft. It was only by beating back the fire with hose streams and using an extension ladder that these people were rescued. Four people were badly burned besides those fatally injured.

Conclusions. Extreme care should be exercised in the handling of lightly inflammable material such as celluloid scrap. This should be kept in standard metal cans with tight fitting covers normally closed.

The number of fires which have occurred just before starting time in the morning suggests the advisability of employees and building owners using drastic measures to prevent lighted cigars or cigarettes being brought into factories. All elevator men or doorkeepers should have instructions not to allow any employee carrying a lighted cigar or cigarette to enter a factory.

Fire escapes running in front of windows other than wired glass in substantial fireproof frames may be quickly rendered useless as means of exit and dangerous to persons thereon.

H-8907. This fire took place in a concrete garage. Driver of tank wagon had just opened an underground storage tank to ascertain the amount of gasoline, and left it open while filling from the tank. He carelessly allowed the tank to overflow so that several gallons of gasoline ran onto the floor. In trying to take it up with a metal coal scoop it is probable that a spark was struck on the concrete floor, causing a severe explosion, which was heard from a considerable distance.

The actual fire loss was small, due to the superior construction of building, which consisted mainly in damage to windows blown out; but the man was killed.

H-9042. This fire took place in a large property devoted to the compounding of petroleum and lubricating oils. Plant was composed of about twenty tanks of two to five hundred gallons capacity, and a few wooden sheds. The fire was caused by the overturning of a soldering pot on the bench and floor which was saturated with oil, and spread rapidly. The firemen directed their efforts to saving a two-story brick building containing a number of filled tanks. The fire gave off an intense heat and volumes of smoke which was drawn upward until a rupture of one of the tanks occurred, resulting in a flow of burning oil into the street. During this

scare a fireman, attempting to get off a ladder, fell and was fatally injured.

Total loss was $176,000.

H-9062. Building was four stories and basement in height and of brick ordinary joisted construction. It was occupied on first floor and basement by a motor service company which operated a garage, manufactured and repaired automobile tires, and kept for sale gasoline, lubricating oils, etc. The fire originated in the basement from explosion of a thirty-gallon drum of gasoline evidently igniting from a lighted cigar or cigarette in the hands of one of the three employees who were in the building at that time. Fire was fought by the city department and after about two and one-half hours was checked and finally extinguished.

Owing to the general poor care and condition of this risk, various inspections had been made and considerable criticism made of the manner in which gasoline was stored in a 680-gallon iron tank placed under the sidewalk. The opening in the basement wall through which this tank had to be carried to be properly placed was not bricked up. This was brought to the owner's attention together with the fact that employees were smoking in the basement. He did not take these criticisms seriously, and the matter was brought before the State Fire Marshal's office, which reported through one of its deputies that conditions were not so bad, and these people were given several days in which to remove this supply tank, or get permission from the city and brick up the opening.

On the morning following the fire a thirty-gallon empty metal drum was found on the street and another in the basement where the fire occurred, which was evidently the direct cause, as the head of this drum was blown off.

The property loss from this fire was not very great, but the loss of the lives of three employees is to be deplored; and it would seem that if the criticisms brought out in previous inspections had been acted upon, this loss of life would not have taken place.

Fire Causes.

The fires here given are selected to illustrate defects, either of construction or superintendence, in the classes of property indicated.

The last two months have seen an unusually large number of fires caused by locomotive sparks. On account of the lack of rain, inflammable material has become very dry and in a condition to take fire from sparks which ordinarily would not have proved dangerous.

People should realize that shingle roofs are additionally hazardous when near steam railroads, also that every open window or shed near railroads, in which inflammable material is stored, invites a fire. The following illustrations of large losses emphasize the danger.

S-14921. This fire in a broom corn warehouse is supposed to have been caused by locomotive sparks coming through broken windows. Fire was held in check by sprinklers, but damage was large, due to susceptibility of stock to water damage. Loss, $10,939.40.

S-14848. This fire started in open side of shed used to store paper stocks, which was exposed to sparks from passing engines. The roof of shed being unusually high, fire probably gained considerable headway before sprinklers opened. One hundred and thirty heads opened and held fire in check. Loss would have been much less if building had been divided by one or more fire walls. Loss $18,267.46.

Lighting.

H-8953. Heat generated by electric light placed on wall paper in wall paper rack after half hour ignited the paper.

Portable lamps should be provided with wire guards to prevent their coming in contact with inflammable material.

S-14803. Fire occurred in card room, due to short circuiting of wires in electric lamp socket, setting card flyings on fire. "Wall" thermostats operated promptly and alarm was received at fire station. Department was a little slow in responding, due to trouble with motor truck.

All wiring should be regularly inspected and maintained in compliance with National Electrical Code rules.

H-8848. Workman hung lantern over near-by empty varnish tank in order to see to clean it out, as electric current was shut off. Naphtha vapor ignited.

S-14726. Short circuit occurred at pendant incandescent electric lamp in card room, igniting flyings on socket, and spread to card. Loss of $1,200 to card clothing on three cards.

Investigation brought out the fact that lighting circuit was fused with twenty-five ampere fuses instead of six ampere, as called for by rules.

Heating.

H-8945. The fire originated from a small upright steam boiler used for heating dry room. Gas was used in the furnace instead of coal, and as the base of the boiler was set on a piece of sheet metal and asbestos, the heat penetrated the supposed protection and set fire to the joist and flooring. Loss $6,613.

An air space should always be left under boilers or stoves.

Matches.

H-8883. Workman scratched match on his trousers. The match broke and burning part fell into dip tank holding two barrels of asphaltum paint. Dip tank is provided with a board cover, but contrary to rules it was not in place.

Cleanliness.

S-14863. Although the exact cause of the fire is unknown it was probably due to lint on the steam pipes. A small sample of this lint showed it to be composed of cotton flyings, etc., which could be ignited.

Steam pipes should be kept free from lint.

H-8914. Grease from mixing room in a bakery soaked through a crack in floor and ran onto boiler uptake.

Electric Iron.

S-14667. Fire started from electric pressing iron which had not been turned off. Current supplying this iron supplied from generators in building, which are usually shut down.

Sparks.

S-14843. Owner was burning a large quantity of old wooden crates, and sparks from the metal stack dropped on the dry shingle roof and started a blaze.

The lesson is obvious.

Miscellaneous.

S-14911. A paper machine had given some trouble by breaking, so the employee thinking that the calendar rolls had become sticky threw on, as was the custom, some kerosene. Immediately there was a flash, igniting the paper on the machine and the large amount that had broken which the employees had not had time to clear away.

S-14845. Fire was supposed to have been caused by children lighting pieces of waste found in the street and dropping them under the elevator door.

Points of Interest from Fire Reports.

These notes are intended to illustrate the efficiency or inefficiency of signaling, retardant or extinguishing agencies.

Automatic Sprinklers.

S-14905. Three of the eight sprinklers which opened were not discharging freely, and in taking the pipe apart to discover the cause a piece of wood about two inches long and one inch in diameter was found in the one and one-quarter-inch elbow.

S-14816. Fire started in basket of hay for packing. Dry-pipe system operated so promptly that seven sprinklers prevented fire from spreading to a large amount of hay stored a few feet away.

Fire Shutters.

H-9023. The loss to building would have been slight if it had been equipped with standard shutters. The iron shutters were subjected to heavy exposure and heat passed through them, causing considerable damage to this building.

Watchman.

H-9008. Colored watchman left plant after closing down dynamo at 11 p.m. and went to a dance, leaving mill unwatched, and did not return until five hours later. Fire probably started from boiler room through his failure to clean up the same before leaving, and communicated to the rest of the mill. Fire was discovered by outsiders at 3.30 a. m. when it had gained too great headway to be extinguished. Total loss $10,000.

Nothing is saved by employing inefficient watchmen because they can be obtained for less wages.

Alarm System.

S-14834. The loss on this fire would not have been so large if there had not been a mistake in the manual transmission of alarms at fire headquarters. This system had just been introduced and the operator sent the apparatus to another box, the fire marshal only coming to the fire.

Construction.

S-14775. The floors of building were of very poor construction, and although the sprinklers extinguished the fire the large amount of water leaking through floor caused a damage of $1,341.

Floors should be made as nearly waterproof as possible.

Storing of Stock.

S-14757. Fire occurred in paper stock which filled end of storehouse from wall to wall and was piled about ten bales on a side. The fire was mostly underneath the pile and consequently nearly all the paper was wet down before it could be extinguished.

This fire calls attention to the undesirability of storing paper stock in such large piles, as it is very difficult to extinguish a fire in the bottom of such a pile.

Inside Protection.

H-8882. Engineer tried to use some unapproved chemical extinguishers, trying seven—all without success.

Only approved apparatus should be bought.